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INTERNAL AND EXTERNAL STATISTICAL NEEDS OF AMERICAN BUSINESS.*

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A foreword of explanation seems appropriate. I shall not attempt to define the oft-used term "business statistics," nor to draw a strict line of demarcation between accounting and statistics—leaving the matter of precise definition and fine distinctions to our academic friends. I shall simply describe conditions and suggest some broad, and perhaps bold, ideas for improvement in the existing order of things.

In approaching the subject of the statistical needs of American business, "business statistics" seemed to divide logically into two categories, internal and external: "*internal*" comprising the statistics compiled by private enterprises for their own direct benefit, *i. e.*, the analysis of a company's own business and data related thereto; and "*external*" comprising statistics compiled by others, such as (1) business indices and barometers, and (2) governmental statistics for general consumption.

INTERNAL NEEDS

Extent of private statistical work:

Under internal needs let us first look at the extent of private statistical work.

It is difficult to determine, even roughly, the amount and character of statistical work done by business concerns, chiefly for two reasons: *first*, it is so varied and often so closely related to regular accounting work, and *second*, no community of interests has existed among those engaged in such work. But we

* Paper read at the seventy-ninth Annual Meeting of the American Statistical Association.

know that there are thousands of large and small business concerns, including public utility corporations, manufacturing and mining industries, wholesale and retail mercantile firms, and financial institutions, which are engaged in statistical work of more or less importance. The most common and best known types of such work are cost accounting studies and analyses of production and sales, since these were the first statistical offshoots from regular accounting work. Also, we should not forget the statistical compilations of trade journals and business associations, and those of private commercial agencies, such as Bradstreet, Dun, Babson, Brookmire, etc.

Statistical data appearing in trade journals and financial papers have grown tremendously in the past few years. A recent survey found over 300 different topics or sets of figures—appearing in over twice as many publications—the same data often appearing in a half-dozen papers or so. Indeed, we only need look at our daily newspapers to realize that the American people are relying more and more on facts as bases for opinions and arguments. Possibly we occasionally attempt to prove too much rather than too little by statistics, especially since much of the product is by no means scientifically correct.

Causes of rapid development of private statistical work:

Three factors appear to have been largely responsible for the rapid development of private statistical work during the last 10 or 15 years:

1. The evolution from small to large business undertakings (industrial combinations).
2. The increase in legislation affecting business, especially public utilities.
3. Progress in the manufacture of mechanical labor-saving devices for accounting and statistical work.

The centralization of administrative policy and control in many lines of industry has made necessary more data and derivative figures than mere corporate accounting affords.

The creation of federal, state and municipal regulatory and investigating bodies has forced statistical development on a large scale among public utility and industrial concerns. Questions involving the amount and character of business,

the cost of production, prices or charges for service, etc., must be studied through the medium of statistics by such investigating and regulatory bodies as well as by the owners and managers. Compensation commissions also need and require much information from the industries within their jurisdiction; and workmen's compensation laws and other employees' disability benefit plans have made it necessary for all large employers of labor to have a knowledge of, and often to undertake their own, statistical work. In short, the requirements now laid on business by governmental bodies can be adequately met only when full statistical records are kept currently.

Mechanical devices have made it possible for private concerns to make statistical compilations and investigations which were formerly prohibitive from the standpoint both of cost and of time.

That business throughout the country still needs to know more about itself is evidenced by a recent statement by the Chairman of the U. S. Federal Trade Commission, who said: "A large proportion of the business men of the country do not know their costs; nine out of ten establishments making several products cannot separate the sales; of 60,000 large corporations, one-half do not charge off a single penny for depreciation." A member of one of the committees of the Council of National Defense stated the other day that if American business had kept better records, the work of the Council would have been greatly simplified and accelerated.

Future needs:

That, in the future, statistical requirements will increase rather than diminish seems certain. The past decade has witnessed many changes in the political, social and industrial life of the nation; but the next few years promise even greater, perhaps revolutionary changes. Statistics will be required as never before by those in high places, both in business and in governmental affairs, as a guide to the right solution of the questions of the day. The statistician will be called upon to furnish these data properly analyzed and correlated.

At the present time much of the statistical work of private

corporations is being done by poorly equipped persons. In many cases the work is done by persons drafted from the accounting and clerical forces; and in some cases the work is carried on merely in conjunction with bookkeeping and accounting work. There are only a few *experienced* men, and practically no *technically* trained workers, now available. The demand for properly trained as well as experienced men to do accurate, scientific work is far greater than the supply. Hardly a month passes without a request coming to our office for a bright young man who can make statistical analyses and illustrate the results graphically. We are also constantly besieged by men and women, young and old, begging assistance on how to conduct statistical investigations which have been called for by their employers. These persons usually have no conception of the theory or method of statistical procedure, and are apt to be poorly equipped mathematically.

The lack of properly trained men is chiefly the result of the lack of adequate training facilities in our educational institutions. I believe I am safe in saying that nowhere in this country is there offered a thoroughly comprehensive course in the theory and method of statistics *coupled with practical application.* The main deficiency in existing courses lies in the inability to teach the application of theory and method by actual laboratory work on real problems and investigations, especially problems and investigations relating to business. Although admitting that the science *is* difficult to teach, we cannot concede that it is impossible to have more effective instruction in the future, *provided* the experience of those now engaged in private statistical work is utilized. Here let me suggest that it would be a good plan for our academic friends to alternate their teaching semesters with actual work in both the private and governmental statistical fields.

Is it not a proper function of the American Statistical Association to foster and promote higher education in statistics? Indeed, I am not so sure but that it would be a good plan to introduce elementary courses in statistics and graphics in the primary and secondary grades of our public school systems. Why should there not be a standing committee in the Association whose duty would be to take the initiative in assisting

colleges and universities to establish up-to-date courses in statistics with especial reference to business needs, and to encourage and supervise the compilation of a sufficient number of text books to adequately cover the field. At present we have only one or two statistical text books, and only one treatise on graphics, by American authors; these are good, but elementary. We are in sore straits for text books that will contribute something towards standardization of tabular and graphic presentations in both business and governmental work.

Although it has come into pretty general use, the graphic method of presenting facts is still only in its infancy and has unlimited possibilities, especially for analysis of corporation accounts. Much of our present graphic product is poor in technique. I have in mind a current weekly periodical, devoted to business and economics, which publishes charts that are without sufficient titles and keys to be self-explanatory and that have to be interpreted by text which is often on another page. Again, many graphics are so complex that they have to be *studied* before their meaning is clear. For most purposes, a chart that has to be studied has no reason for existence.

About a year ago, a committee on standard rules for graphic construction made a preliminary report concerning some 17 basic rules.* These rules were excellent so far as they went; but the report was only a beginning, and the committee seems to have languished and died like most voluntary efforts. Irving Fisher's booklet, "The 'ratio' chart for plotting statistics," gave us some valuable hints on the use of logarithmic scales. Field (Chicago) has also recently made a valuable contribution to the same subject.† Logarithmic scales are too little understood in the business world, and these two works have helped to show us their usefulness. Such contributions are, however, necessarily limited. Private individuals have neither the time nor the resources required adequately to cover the field.

The American Statistical Association has in the past confined its deliberations and publications almost exclusively to

* The committee was composed of representatives from seventeen scientific societies. The preliminary report can be purchased from the American Society of Mechanical Engineers, 29 West 39th Street, New York City.

† See The Journal of Political Economy, October, 1917.

the academic and governmental field of statistical activities. May I suggest that it is time for the Association to awaken to a fuller realization of the fact that the compilation and interpretation of facts now attends, or should attend, all important business undertakings, and that the field of statistical accomplishment no longer lies exclusively in institutions of learning and governmental bureaus. In other words, business is trying to put the theories of the academicians into actual practice, but is not getting the assistance it needs from them in return. Indeed, some of the most helpful and illuminating current thought on the science appears not in the American Statistical Association publications, but in the publications of other scientific associations.

EXTERNAL NEEDS

Before considering the needs that lie entirely outside of the field of private activities, I want to call attention to a phase of business statistical work quite different from that which I have already mentioned. It is this: Industrial and commercial enterprises are being vitally affected by the results of statistical studies, inquiries and investigations made by government bureaus and commissions—and by private organizations and individuals—of varying degrees of competence.

Business interests have, for the most part, been too prone to accept meekly the statistical results by which they have been judged; and too often they have replied in non-statistical terms or by general denials. This situation is wrong. Business should take part in these studies and results, not with a view to concealing or distorting facts, but in a spirit of coöperation and mutual helpfulness and seeking after the truth. We must remember that statistics have a large potential value in shaping public opinion, and that this is true also if the statistics are faulty but are not refuted. Agitators and enthusiasts are constantly appearing before legislative bodies with extravagant claims and ridiculous data. In these cases it is the duty of the interest affected to meet such misstatements with a presentation of the *facts*. But this cannot be done unless business secure competent statisticians, and where are they to be found in sufficient numbers?

Let us now look at some external statistical needs of business from the standpoint of *existing material*, and *additional data and treatment needed*, remembering that we have already divided this part of the discussion into two main categories: (1) statistics relating purely to business, and (2) governmental statistics for general consumption. The speaker may perhaps be excused if he indulges in criticism of governmental statistical work because of his former association therewith.

Business—existing material:

Only a few years ago one or two sets of figures, *e. g.*, railroad earnings or bank clearings, were considered sufficient to indicate the condition and trend of business in general. As commercial and industrial life expanded and became more complex, both at home and abroad, however, it became necessary to consider more factors to secure the desired present and future vision; and then we began to have trouble in comparing one factor with another and in giving each its proper weight in our mental calculations. We find that we need a *composite* result, but here we are confronted with many difficulties. What factors or items shall be selected? What method of combining and weighting, if any, shall be used? What base shall we take against which to measure changes? What shall be done with seasonal and cyclical trends? Before we have gone far into the consideration of these questions, we discover the phenomenon of business cycles and find the solution of our problem still more difficult.

Babson's and Brookmire's statistical charts and services have attempted to solve these problems, and Mitchell has given us some wonderfully illuminating data in his study on business cycles. While in no way depreciating the efforts of Babson, Brookmire, or Mitchell—for they have done pioneer work—nevertheless, we are forced to the conclusion that the results given us rest largely on a basis of *judgment* of the compilers, and that these perplexing problems can only be solved by additional research and analyses.

Babson and Brookmire differ as to the factors selected, method of combining and theory. Babson does not eliminate cyclical trend, but computes and shows it as the XY line in

his composite plot. It is only fair to state, however, that Babson has recently been issuing a series of charts that does eliminate growth. Brookmire, on the other hand, computes and eliminates the cyclical trend and shows a horizontal "normal" line OP. Who shall say which is right?

Thanks to Persons (Harvard) and King (West Va.), we now have some light on some of these matters. In a most admirable study, Persons tested, by means of the Pearsonian coefficient of correlation, the significance of 25 items or series generally used as business indices, and found nine whose fluctuations are *concurrent* and which are therefore proper to use in constructing a business barometer, and five whose fluctuations *precede* those of the nine and which are therefore useful in forecasting business changes.* It should be noted here that Persons' study was based on *annual* data, and, as the author states, further investigation based on quarterly and monthly observations is necessary to reach final conclusions.

Similarly King tested, by the same method, some of Mitchell's conclusions regarding cyclical movements of certain price series. His analysis supports Mitchell in some conclusions, but differs in others.† Here again *annual* data are shown not to be sufficient for the final and conclusive test to which Mitchell and King have but pointed the way.

Business—additional data and treatment needed:

It appears that the compilations of basic data, especially data used as business indices, are fairly ample;‡ and, furthermore, there is no evidence but that these compilations, in general, are sufficiently well made to serve all practical purposes. But American business interests, and the government as well, need a properly constructed, comprehensive business barometer, or a series of barometers, and a business forecast, if it is possible to construct them. Whether the construction

* The nine concurrent items are—railroad gross receipts, railroad net receipts, coal production, exports, imports, pig iron production, price of pig iron, immigration, and wholesale prices. The five preceding items are—sales on New York Stock Exchange, price of same, bank clearings (corrected), new railroad mileage, and business failures. See The American Economic Review, December, 1916.

† See The Quarterly Journal of Economics, August, 1917.

‡ At least one possible exception to the sufficiency of available data should be noted: *i. e.*, U. S. Post Office receipts. They were published for a selected number of large cities up to a few years ago. Their publication should be resumed.

of such a barometer and forecast is a proper government function, or is one that should be left to private initiative, is a question that can not be intelligently answered until we have further light on the subject. And it is here that the government can do a constructive piece of work for American business. The vast amount of mathematical and research work necessary before we can reach a proper solution of the difficulties that attend these statistical problems is too much for private enterprise to undertake at present. The government ought, at least, to continue the studies of Persons, King and Mitchell.

The idea of a governmental index of this kind is not a new one. About 1907, the French government appointed a commission, composed of governmental officials, bankers, statisticians and economists, to study the possibility of constructing one or more general business indices. The commission reported that certain factors or series could be used; but a composite business barometer was not constructed.*

Right in line with work of this character, Dr. Hoffman has recently proposed weekly or monthly government index numbers of national health and social well-being, including index numbers of—

The general urban death rate
The sickness rate in industry
The accident rate in industry
Number of arrests in large cities
City expenditures for poor relief
Ratio of unemployment.

He also suggested that possibly all these index numbers could be combined into one general index for the entire country,† and pointed out that comparatively few new data would need to be collected. The speaker heartily seconds Dr. Hoffman's suggestion. It is this kind of work, especially the accident and sickness rates in industry and the unemployment ratios, that the business interests of the country need—something concrete and up-to-date.‡

* Cf. Persons' article in The American Economic Review, December, 1916.

† See Economic World, July 7, 1917.

‡ Evidently as an outgrowth of Dr. Hoffman's suggestion, the Bureau of the Census has recently begun the publication of a Weekly Health Index. It is a step in the right direction, but the results thus far are not all that could be desired.

Governmental—existing material:

The amount of data collected annually, quinquennially, and decennially by our government is enormous and covers practically the entire range of human activities, *except* the field of wholesale and retail trade, and the distribution of the wealth and income of our people. Indeed, this country takes first rank among the nations of the world in the amount and the frequency of statistics gathered and published. To one familiar with governmental statistical activities, their bulk is appalling, and one is prompted to ask, Is it all necessary and serving a useful purpose? I am inclined to believe that it is not so much a question of over production as one of poor production, poor in the sense of lacking coördination, correlation and interpretation. In other words, it is not sufficiently digested before given to the public.

Governmental—additional data and treatment needed:

It would hardly seem that we could possibly need any more government statistics; but we do. We need *annual* production figures for both manufactures and agriculture. Our five-year censuses of manufactures no longer suffice to show the rapid industrial changes which are taking place in this country. If this present world war terminates by 1920 and if conditions are then restored to anywhere near a normal or pre-war basis, the tremendous expansion and change in the complexion of American industries due to the war will be completely lost in the federal statistics. We also need better industry classifications, details on kind and quantity for more products, and classified wage schedules of industrial workers.

The annual farm production estimates of the Department of Agriculture serve in a measure to fill the gap between the ten-year agricultural Census enumerations; but either these estimates should be further improved, or else a limited annual production census should be taken by the Census Bureau. Government statistical work, in general, has been conducted too much from the standpoint of history. We need *current* facts to guide administrative and legislative policies in affairs, both public and private.

But even more important than additional data is the need for coördination of present governmental statistical work and for better analysis and correlation of the results of this work. The following will illustrate:

(a) We have historical statistics on population and agriculture, but where is there a comprehensive study correlating the two? Present world conditions have served to revive interest in the Malthusian theory, but do we yet know the facts?

(b) The Census gives us an estimate of the wealth of the country every 10 years, but where, *except* in Wilford I. King's recent work, is there any attempt at scientific analysis of the sources and distribution of wealth, and the amount of the national income and savings therefrom?*

(c) The Bureau of Labor Statistics publishes data on relative prices and wages, but where is there a composite index of the increased cost of living in various localities and occupations, *except* a few general studies like Rubinow's? This is a vital question in present wage controversies, but we have practically no conclusive data.

(d) The Census publishes figures on domestic production by industries, and another bureau the statistics of our foreign commerce; but, on account of the differences in classification, etc., it is not possible to compare one with the other to any great extent. Again, where are there any official figures on the effect of higher prices on the money aggregate by which we measure our foreign and domestic trade? What about the actual volume?

(e) The Department of Agriculture recently gave us an annual estimate of $21,000,000,000 of farm products, but did it tell us that the total includes billions of duplications due to the feeding of crops to live stock, or an estimate of the amount of this duplication?

(f) Why do we not have a complete monthly government index, or catalog, of the mass of material which the various

* During the past few months we have witnessed the efforts of government officials and others to prove that our national resources are ample to meet huge war costs, and practically the only figures available were King's and how they have been misinterpreted and misused! We glibly quote $250,000,000,000 of wealth, but how much is fixed and how much is liquid? It is well to remember that fixed capital is of use to the government only as a going concern.

departments and bureaus gather, compile and publish? Much valuable information never reaches business concerns because they do not know that it exists.

(g) Congress has appropriated $20,000,000,000 for the conduct of war, but what governmental agency has compiled a comprehensive budget showing sources of income, character of expenditures, methods of financing, etc.? The only intelligent statements have come from some of the New York City financial institutions.

(h) Upon the vital question of the division of income between capital and labor, where have we any helpful official studies of a late date?

These are only a few examples of where and how our present governmental activities fall short of giving American business the statistical information it needs and *pays for;* they could be extended *ad libitum.*

Further proof of the lack of coördination and proper analysis of our official statistics is found in the administrative conduct of the present war, so far as the determination of facts upon which to base executive action and policy is concerned. One would naturally suppose that the newly created war bodies, such as the Shipping Board, the Food and Fuel Administrations, the Export and Priority Boards, the Council of National Defense, etc., would turn to existing statistical bureaus for most, if not all, of their information. Apparently they have not done so to any great extent; on the contrary, they have felt it necessary to largely conduct their own investigations and studies. The speaker was surprised to learn, upon a recent visit to Washington, that the Census Bureau (the largest statistical office in the world) is not now, nor has it been, engaged to any extent on war work, but is pursuing the even tenor of its ways on peace-time investigations which might well be suspended so that the entire staff of the Bureau could be released for use in conducting war investigations and preparing war compilations.*

* It is recognised that much of the war work is specialized and should be done in the respective organizations or close thereto. But the personnel and equipment of the Census Bureau should be utilized somehow, even if it be necessary to temporarily transfer some of its units to war offices. In this connection, it is suggested that 5,000 employees might be found in the various departments at Washington who could be transferred to direct war work for which there is a dearth of workers.

Is not this condition a sad commentary on the insufficiency of the statistical product of our permanent bureaus in Washington? Does it not indicate that they have failed to measure up to the demand for current concise facts, or, at least are lacking in vision and initiative?

We have been spending millions of dollars annually for governmental statistics which have inadequately met the current needs of the business interests of the country and have failed the government itself in a war emergency. What is the remedy? How can the mass of statistical data collected by the government be vitalized and made more useful? The only answer seems to be the establishment of an *independent* government bureau of statistical administration, research and analysis, which would not be a part of any existing government department or statistical office. Such a bureau should be provided with the best expert statisticians and economists the country affords. Their tenure of office should be so limited as to keep the bureau alive and progressive, and their appointments arranged to insure continuity of work. The commercial, industrial and labor interests of the country might well be represented also. Indeed, I suggest that nominations for the commissioners in such a bureau be made by popular vote at the annual meetings of the American Statistical and Economic Associations, and that the U. S. Chamber of Commerce and the American Federation of Labor, respectively, make nominations for the representatives of commerce, industry and labor. Let the scope of the work of the bureau be worthy of the best thought and experience of the men most distinguished in their respective callings, so that it would be a crowning achievement and highest honor to have been chosen to direct, or to participate in, the work. Moreover, in addition to the functions already indicated, such a bureau should be a central clearing house on all official statistical matters, and should exercise a stimulating and supervisory oversight on the work of the various departmental bureaus. It should also promote international statistical studies and comparisons—a function that will be especially important during the reconstruction period following the war.* Congress

*"The Office of National and International Statistics" might be an appropriate name for the new bureau.

needs to be supplied with a large volume of convincing facts; both old and new war bureaus and boards must have adequate statistical information for the conduct of their work; and business of the country is relying more and more on specialized and general statistics in this period of war adjustments. There is plenty of work for the new bureau to do.

To the intelligent and liberal use of statistics, must be credited much of England's remarkable success in creating her wonderful war machine and in organizing the resources of the nation back of it. Our English cousins have perhaps a keener appreciation of the value of statistics, especially in war work, than have we Americans.*

Now would seem to be a propitious time to secure the necessary legislative action for the establishment of the proposed new statistical bureau. I believe that if the scientific bodies gathered in this city this week were to get behind such a project and were to join with the Chamber of Commerce of the United States, the creation of the bureau could be accomplished during the present session of Congress. Here is another opportunity for the American Statistical Association to do a constructive piece of work, and take the leadership in advancing statistical science in this country. Will it seize it, or will it continue to be largely a debating and mutual admiration society?

Recapitulation:

(1) *Internally* American business needs more and better equipped men to do its statistical work, and suggests that the American Statistical Association foster and promote higher education in statistics and encourage the publication of adequate text books.

(2) *Externally* American business needs, principally, three things:

(a) Further studies, by the government, on the construction of business barometers and forecasts and the establishment of certain indices relating to social well-being.

* Sir Eric Geddes has a penchant for statistics. In a recent interview he said: "I statistise everything. Knowledge is power and statistics are the throttle valves of every business. But don't let statistics master you—use them."

(b) Annual official production figures on manufactures and agriculture; a revision of industry classifications; details of kind and quantity for more products; and classified wage schedules for industrial workers.

(c) Better coördination of existing government statistical work, and correlation and scientific analysis of the material now collected and published.

Business also urges the creation of an *independent* federal bureau, manned by the best experts the country affords, to the end that government statistics may be vitalized and made more useful, the establishment of this bureau to be accomplished by the American Statistical Association joining with other scientific bodies in securing the necessary legislation during this session of Congress.

President Wilson has truly said, "Facts are our masters now." But, gentlemen of this Association, are we masters of the facts? I fear we have far, very far to go before we can answer in the affirmative.

A PHASE OF THE EXTERNAL STATISTICAL NEEDS OF AMERICAN BUSINESS.*

By Earle Clark

There is an increasing demand on the part of business executives for statistics concerning general economic, social, and political conditions which affect the interests of business organizations. Statistics of this kind, used for business purposes, may be described as "external business statistics," as distinguished from "internal business statistics," which consist in a quantitative analysis of the accounts and affairs of an individual commercial or industrial concern.

For statistics relating to general conditions, the business world is largely dependent upon the official statisticians of the federal and state governments. One urgent statistical need of American business consists in an extension of the work done by governmental agencies which is useful to business. This need has been described and emphasized by Mr. William A. Hathaway, in a paper appearing in the current number of this Quarterly.

It is the purpose of the present paper to show that private business interests should take part in some statistical activities which have heretofore been left to the statisticians of governmental bureaus and commissions. The need for this work is due to the connection which exists between the statistical activities of the government and the welfare of business organizations. The work to be done consists, in brief, in the scrutiny, verification, and, in some instances, amplification of official statistics by the statisticians of business concerns.

I. A GOVERNMENT BUREAU OF STATISTICAL ADMINISTRATION, RESEARCH, AND ANALYSIS.

Because of its evident bearing upon the production and interpretation of statistics affecting business interests, a suggestion made by Mr. Hathaway, in the paper referred to above, will be commented upon at the beginning of the present dis-

* Paper read at the seventy-ninth Annual Meeting of the American Statistical Association.

cussion. Mr. Hathaway recommends, as a means of serving an urgent statistical need of business, the creation of a federal bureau to be charged with supervising, supplementing, and interpreting official statistics. There are obstacles to the creation of such a bureau, but they are not insuperable, and the work of such an organization should be of value, not only to private business interests, but to the entire public. It may be well to give examples of the tasks that such a bureau should assume, and also to mention a danger to be avoided.

Examples of Tasks to Be Assumed.—One of the first functions to be exercised by the proposed organization should be that of harmonizing the statistical work of the different government bureaus and commissions. The United States has a tariff system which was created in the interest of our manufacturing industries. Even when the tariff schedules are revised with emphasis on their revenue producing features, the interests of industry must be, and are, considered. We have statistics of imports and of revenues, and also statistics of manufactures, but the two groups of statistics are wholly independent and, for the most part, cannot be reconciled. It may not be possible to take a census of manufactures with all the detail as to products adopted in a tariff schedule, but a bureau of the kind Mr. Hathaway recommends should seek to have the broader groupings of one mass of data made comparable with the groupings of the other.

Another task for a bureau of research is the elimination of duplication in gathering statistics. Anyone who has collected information upon government schedules has probably had the experience of being assured by a manufacturer that he is ready to give the facts asked for, but that he gave these same facts to another representative of the government about a month before, and similar facts to a third representative within the half year.

The illustrations just cited are not novel ones; they relate to needs generally recognized by statisticians. To emphasize them and repeat them may assist in bringing about an improvement in conditions.

A Danger to Be Provided Against.—In creating a bureau for the coördination and interpretation of official statistics, it

would be necessary to provide against a development that might seriously impair its usefulness. Such an organization must possess, if it is to be efficient, large statistical powers; it must be able to commandeer data from a number of sources; and its statisticians must have free hand in selecting the methods to be used in assembling and interpreting statistics. The conclusions of the bureau would appear to have behind them all the authority of the government. By reason of this concentration of power and authority it is conceivable that some of the findings of the bureau might be accepted for more than they were really worth. To say this is not to reflect upon the quality of the work that would be done, nor the qualifications of the statisticians who would do it. But no statistician is infallible. That the statisticians would seek to exaggerate the importance of their results is not probable, but it is possible that the public would be inclined to accept findings of the bureau at their face value, without much inquiry as to the facts and reasoning on which they were based.

The private agencies which endeavor to interpret economic statistics presumably make mistakes, but business is not dependent on the output of any one organization. The results of one agency can be checked by those of another. If faith is lost in one organization, it can be discarded for others. And when different organizations, proceeding independently, reach the same conclusions, these conclusions have additional weight. In the interpretation of economic statistics, competition is desirable.

The remedy for the danger referred to consists in the presentation, by the interpreting bureau, of its original data, together with a full and clear statement as to the methods by which conclusions are reached. If such statements were made, methods and results could be checked, and would be checked, by the representatives of private business enterprises.

II. A NEW FIELD FOR BUSINESS STATISTICS.

Consideration of the statistical work on the part of business organizations that is made necessary or expedient by the statistical activities of the Government involves: (1) a statement of the basis of the need for work of this kind, (2) a broad class-

ification of the work according to both (a) the processes employed and (b) methods of presentation, and (3) a consideration of the relation of the work to the interests of the public.

Basis of Need for Work.—The need for statistical activity of the type mentioned has its source in the effects of governmental authority upon business enterprises. In times of war, government control is more evident than usual; price fixing, for example, is a relatively new extension of governmental power; but at all times the influence of what is done by the state and federal authorities greatly exceeds what would commonly be described as government regulation of business. Thus, the enactment of a tariff law is not, in the accepted sense, government regulation, but such a law may result in a marked change in the conditions under which industry works. Business interests are affected, also, by revenue laws and by legislation adopted in the interest of wage earners and of the public, as, for example, laws fixing the hours of labor, laws regulating the employment of women and minors, minimum wage laws, factory inspection laws, and laws providing for the inspection of manufactured products. Railway rate making is a form of government activity which affects, not only the railroads, but all phases of business life.

Legislation of this kind is based, in increasing measure, upon the results of statistical inquiries, studies, and investigations, carried on by commissions, bureaus, councils, public and private, of varying statistical competency. Our statistical libraries largely consist of reports of investigations which have been authorized in order that they might serve as the basis for legislation, and which have in many cases been fruitful of legislative results. The list includes, for example, the reports of state and federal commissions on industrial relations, the minimum wage, immigration, etc. Moreover, in formulating and debating laws, reference is constantly made to bodies of existing data, such as the reports of the Bureau of the Census and other permanent government offices. Revenue laws and tariff laws are enacted with reference to statistics gathered and compiled for the purpose, or drawn from existing sources.

It follows that the interests of business are directly affected by the quality and amount of the statistical work done by the

different government offices. Naturally, this work shows wide differences. Some of it represents the high water mark of our statistical accomplishment, much is of good average quality, and some is unintelligent, misleading, unenlightening. Again, the output of a statistical office does not always exhaust the subject to which it relates. Lack of comprehensiveness in data used as the foundation of legislation affecting business, and the possible presence of imperfections, impose a burden of statistical work upon business interests.

In the past business concerns have, in general, accepted passively the statistical results by which they have been judged, or have replied in irrelevant, non-statistical terms, as by general denials and denunciations. They have been accused of attempting to affect legislation by the exercise of political influence. Moreover, in hearings before government commissions, congressional committees, etc. in which statistics have been involved, corporations have usually left the presentation of their interests in the hands of their legal departments, with the result that pertinent, valid, and reasonably conclusive statistical arguments have sometimes been subordinated to attempts to confuse or discredit witnesses, and generally to "befuddle" the issue.

The policy, or lack of policy, just described has no doubt been due to a blind faith in the government as a source of statistical information, a faith sustained by the high quality of some of the work of the Bureau of the Census, the Bureau of Labor Statistics, and other offices. The attitude of business has been that the government is doing the work, and that duplication is superfluous. This policy is not followed with respect to other types of governmental activity. An inquiry as to whether or not a given combination of interests involved a violation of the anti-trust law would not be left wholly to the office of the Attorney General. The problem would be studied with care by the lawyers of the companies affected. The statistical offices of the government are no more infallible than its legal offices.

In the future, business concerns will find it to their advantage to retain the services of statisticians who will follow up the statistical activities of governmental organizations which have

a bearing, direct or indirect, upon business interests, and will initiate inquiries in the business field with a view to influencing public opinion and action. This aspect of the statistical activity of business organizations will consist in separating the statistical wheat from the chaff, and in doing every thing possible to augment the supply of wheat. Some of the work will be carried on by single corporations, and some by associations of corporations having a common interest.

Already there has been some development of activity in this field. An example is the work of the Bureau of Railway Economics which "was organized in 1910, for the purpose of studying scientifically the various problems with which the railways are concerned and preparing studies and statistical compilations for the use of the railways and for general distribution." Statistical data are compiled, also, by trade associations, chambers of commerce, etc., but the gathering of statistics by such organizations is usually subordinate to other activities, and the results are seldom brought into direct relation with those obtained by the government. The Iron and Steel Institute is an example of an association collecting and compiling statistics.

Classification of Work: Procedure.—Classified according to procedure, the work to be done will include: (1) a careful scrutiny of statistics affecting business compiled by government agencies, (2) the making of studies in the business field parallel to those made by the government, (3) the utilization of existing statistics concerning questions at issue, and (4) the searching of the entire statistical field for data bearing on the relation between business and the government.

To say that government reports should be scrutinized and verified is not a reflection upon the competency of the persons preparing them. Any important statistical inquiry, as, for example, the determination of the trend of prices, involves a multitude of technical decisions. Upon many of these matters there may be differences of professional opinion.

The scrutiny of a statistical report means much more than a checking of the arithmetic, though this is sometimes useful; it involves a review of sources and of methods, including the collection of information, tabulation, interpretation, and pres-

entation. Unanticipated results may sometimes be obtained by taking the raw material of a study and treating it by methods differing from those employed by the official statisticians.

It is well to emphasize the value of this phase of the activity of private interests. Inaccuracy and inconclusiveness are among the most serious faults of statistical work. It seems that too many people are compiling and interpreting statistics as compared with the number who are scrutinizing, testing, verifying, and when necessary condemning the output. If a given statistical product is sufficiently voluminous, laborious, and intricate, it is quite likely to be taken at its face value because there is no one whose business it is to work it through or think it through in a critical way. Verifying a report intelligently and conscientiously may require as much labor as was contributed by the person who prepared it.

Scrutinizing and reviewing reports will be, perhaps, the most significant and useful external activity of business statistical offices. But the work of these offices will not stop with this. Inquiries bearing upon business problems can often be initiated at the same time by the government and by the interests directly affected; an inquiry by a business concern may sometimes anticipate that by the government and, if the inquiry is careful and the presentation is full and clear, may do away with the necessity for an official investigation.

Classification of Work: Presentation.—With respect to presentation, the statistical activity that is being considered may be expected to take at least three forms, as follows: (1) reports to the officers of a company, for their guidance and information regarding a given situation, in order that they may decide what policies are desirable and practicable, (2) statements to be published in newspapers or periodicals, as contributions or as advertisements, for the information of the public and the shaping of opinion, and (3) reports or statements direct to governmental bodies, in the form of testimony or memoranda.

In all three types of presentation, but especially in the first two, the graphical method will be used.

In presenting statistics to governmental boards or committees, in the form of testimony, there will be occasion for cooperation with the legal departments of corporations. To some statisticians and accountants it may appear that the intervention of lawyers in such cases is unnecessary, but it must be borne in mind that the machinery of governmental hearings is organized upon a legalistic basis, that many of the members of committees and commissions are themselves lawyers, and that some of the interests involved are usually represented by legal talent. This being so, it is probably inadvisable to proceed without legal aid, though the statistician will supply the subject matter, and should be able to bring about modifications in the way in which it is presented.

Effect of Work on Interests of Public.—The statistical work described will benefit the private enterprises by which it is supported; it will also contribute to the public welfare. It will benefit the public in two ways: first, by helping to establish the truth concerning questions of importance, and, second, by contributing to the advancement of statistical science.

The work will be competitive—in a sense, controversial. This fact will make for reliable results. The certainty that the product of a government office will be subjected to thorough examination will constitute a powerful incentive to painstaking and intelligent workmanship. The statisticians of business concerns, in turn, will realize that their findings will be carefully scrutinized. Much of their output will be critical, and the critic, above all others, must be sure of his facts and of his processes.

In seeking to establish the truth as to questions at issue, statisticians of business organizations will apply and test statistical methods. New devices and procedures will be developed, and these will be of value not only in the business field but in all the sciences.

THE SCOPE OF BUSINESS STATISTICS.*

By ROLAND P. FALKNER, *Alexander Hamilton Institute.*

Books and articles upon business topics multiply in these days with the rapidity of the traditional rabbit. Among them we frequently encounter the phrase "business statistics." Is it not time that those who claim to be statisticians should welcome the new comer and find a place for him at the family table? In doing so we must not be guided by purely theoretical criteria as to what constitutes statistics, but must consider whether what passes under the name of "business statistics" really serves some useful purpose. If it does so, it will survive whether it is formally recognized or not.

It must I think be acknowledged that the term "business statistics" is not, as many seem to think, self-explanatory. It is true that it has been used rather loosely to designate any statistics which are of interest to business. It has been made to cover the interest of business men in general statistics, or the utilization of general statistics for business purposes. It is pointed out that statistics of manufactures, of foreign trade, of railways, of banks, prices, wages, stocks and a host of others are not only the fruit of business activities but that their conclusions may be helpful in the conduct of business enterprises.

This is certainly true and points out manifold relations between statistical investigations and business undertakings that the purely academic statistician often overlooks. But on the other hand it does not justify the calling of such statistics, "business statistics." We have long known them under the name of "economic statistics," and knowledge is not increased by calling old things by new names. We may admit the close relationship between economics and business without making the terms interchangeable. There are some indeed who, as I think with much justification, call economics "the science of business." By such an expression they call attention to the fact that economics formulates the general principles which lie at the base of all business activity. On the other

*Abstract of discussion at the seventy-ninth Annual Meeting of the American Statistical Association.

hand "business" as the word is generally used refers to the rules and practice of individual business undertakings. We impair the usefulness of language when we obliterate the distinctions between different expressions.

I trust that it will not appear as if these considerations have been put forward for the mere pleasure of dwelling upon the obvious. There has not been to my knowledge any attempt to define "business statistics" and we can only infer what men mean by the use which they make of terms. There has been no effort of which I am aware to describe carefully the field of business statistics, and determine its relation to other fields of statistical effort. Perhaps the recent publication of a series of essays to which the editor, Dr. Copeland, has given the label "Business Statistics" may be deemed the first faltering step toward a comprehensive survey of the field. But the very nature of the book precludes anything like a well-ordered, systematic presentation of the subject. Neither in its plan nor its detail will you find a clear-cut conception of what is or what ought to be the distinctive field of business statistics. You will, however, find innumerable references to the business use of general statistics, which if you agree with what has thus far been said, ought not to be designated as "business statistics."

If this were the only thing that writers call "business statistics" we could make short shrift with this designation and without further ado cast it into the limbo of outer darkness. But a study of business literature in its original sources or in Dr. Copeland's excerpts shows that "business statistics" goes much beyond this.

We read in one of the essays that Dr. Copeland has selected that "business is more and more probing into the past for a solid basis of fact upon which to base future growth." Here I think we find a definite concept of distinctive business statistics—a record of past achievements within a business enterprise so ordered and arranged that it can serve as a basis of future policies.

Here there seems to be a plant indigenous to business and unlike any other which the statistical botanist has been called upon to classify. Moreover, it has borne rich fruits.

Through that constant research into the operations of individual enterprises we are gradually accumulating a large store of information on such topics as production, sales, stock turnover, advertising, employment, labor turnover, service rendered and similar topics.

It might be objected that however interesting such knowledge might be, it is individual, not general, and therefore not statistical. The objection sounds plausible in suggesting a distinction between results of purely casual and of systematic observation. But it is not valid in its assumption that systematic observation must comprehend the totality of the field under review. If we were to make the universality of the observation the criterion of what might be called statistics, we should have to throw into the discard many well-established branches of statistics, especially in the economic field. After all the only pertinent inquiry is whether the figures involved have been gathered and whether they are utilized in accordance with sound statistical methods.

That business in gathering its data is proceeding by statistical methods is at once suggested by the phrase before quoted, that it is probing into the records of the past. In other words, it is not content with present records, is too impatient to wait for future results, but is reconstituting as far as possible, past experience on a basis which will afford a comparable record. Indeed an examination into the concrete materials which have been quarried from business records shows that there is greater opportunity for statistical comparisons and conclusions than would at first glance seem probable. There is not only the obvious comparison in time between business results of today and yesterday expressed in terms of figures, but also ratios which may be established between the different component elements of these results, and not infrequently comparisons with other enterprises of an analogous character.

There is not the slightest question in my mind that as statisticians, we should recognize a field of business statistics, which is the natural outgrowth of business administration, just as government statistics are the result of political administration. It is a familiar fact that statistics as we commonly know them have their roots in some administrative necessity

of the government, a rule almost without exception. They are at once the fruit of government administration and the necessary basis for its actions.

Administration is nothing more than the business of conducting the government's operations. At a time when statistics had their birth the task of government administration was probably the biggest form of business. It was, moreover, a business conducted through many agents where responsibility could only be defined by a system of definite reports and extensive records. Now the point which I should like to drive home is that, when any continuous undertaking attains a certain magnitude of operation, it naturally resorts to statistics. It is immaterial whether the undertaking be public, one of government, or private, one of business. The magnitude of modern business undertakings is therefore the underlying cause of the development of business statistics. Not a few of our modern enterprises surpass in the extent of their operations, many governmental administrations. Private administrations of this order feel the same need for comprehensive statistics (records of operations) as do nations, states and cities. Thus we note a further analogy between business statistics and the more familiar government statistics.

It follows from the fact that business statistics are the outgrowth of the records of individual business enterprises that in their specific content they will be as diverse as the sources from which they spring. This does not, however, preclude a family likeness in the results obtained from different establishments in the same line of business activity. Nor does the diversity in specific contents render futile an attempt to classify the results of business statistics into certain large groups which exhibit the scope and possibilities of such statistics.

To my mind what is most needed in this field of statistics today is a clear-cut conception of what the field actually is. If the business man has a comprehensive view of the kind of information obtainable by statistical research in business he can judge more intelligently whether in his own particular business he can derive profit from definite information of this sort concerning his own operations. Thus an intelligent understanding of what business statistics is may serve to enrich the

product which is now available for practical and scientific purposes.

An examination of the material which has thus far been published under the name of "business statistics" leads me to believe that it may be summarized as an analysis of three things—work done, expense incurred, and service rendered.

In a factory the work done is represented by the number and kinds of its products. Here cost accounting deals with the units while business statistics are concerned with the aggregates. In a sales organization whether it be that of a factory, a mercantile establishment or an office (*e. g.*, an insurance company), the work done consists of the number of things of each kind which are sold. The accountant makes an accurate record of the financial results of these operations while the statistician takes especial cognizance of the items which enter into these results.

In any business the expense incurred whether it be for materials purchased for production, goods bought to be sold again, supplies purchased, labor hired or what not, finds an expression in the books of accounts. These records are concerned chiefly with values. The statistician analyzes the various items of expense by quantities and kinds, and thus supplements the work of the accountant. As a specific illustration of this expense analysis reference might be made to the careful and comprehensive records which have been developed by well organized advertising departments.

Again business statistics deal with services rendered, and this includes the service of employees and the service rendered to customers. The books of account tell us, for example, the amount expended in labor. An analysis of the persons receiving these payments has led in some concerns to an intimate knowledge of the labor turnover and to the adoption of business policies designed to reduce it. It has illuminated the causes of shifting within the labor force. The sales manager who compares the records of his salesmen also analyzes service rendered.

Service to customers has had a careful analysis by public service corporations, and banks and many mercantile establishments have found it profitable to make similar studies.

Briefly outlined such seems to me to be the field within which we can look for a development of business statistics. Just how widely it will be cultivated in the future depends of course upon the judgment of the individual business man. But it has been born of necessity, the growth in size of individual enterprises. That need according to all the probabilities, will be greater in the future than in the past.

In the field under consideration accounting and statistics touch one another closely. Indeed much of our present knowledge in this field has been the work of accounting departments. So far as this is the case it would be correct to say that while some business statistics have been the product of accountants, they are not the fruit of accounting. A homely illustration will perhaps serve to bring out the close relationship and the clear distinction between accounting and business statistics. One of the most wearisome though essential features in bookkeeping is the making out of invoices. On the left hand side of the paper one enters goods, quantities and prices which appear only as a means to an end namely the money results recorded at the right of the page. Now business statistics takes up these neglected elements and analyzes them. It speaks in terms of quantities and kinds, while accounting deals with values. Each is concerned with business operations, but each views them through different glasses.

The business world is keenly alive to its statistical needs. It is much to be desired that the development of its statistical products should enlist the interest of trained statisticians and not be left entirely to the devices of the accountant, or the vagaries of untrained business experts.

INFANT MORTALITY STUDIES OF THE CHILDREN'S BUREAU.*

By Robert M. Woodbury.

Infant mortality studies have been made by the Children's Bureau in eight cities,† characterized by various and industrial and social conditions. The reports for Johnstown, Pa., and Manchester, N. H., have already been published. Besides these, field studies have been made in Saginaw, Mich., Waterbury, Conn., Brockton and New Bedford, Mass., Akron, Ohio, and Baltimore, Md. Of these cities Baltimore is in many respects the most interesting since it contains a large negro population; the data here are for a large number of births and deaths and offer therefore a basis for valid conclusions on many interesting problems.

The object of these studies is to show the causes of infant mortality and the relation between the mortality rates and social, economic, and physical‡ factors. For this purpose as well as for the purpose of comparing rates under different industrial conditions, infant mortality rates must be available that are substantially accurate. Records of births and deaths of the Census Bureau are indeed available for calculating rates for cities in the birth registration area, but the margin of error varies from city to city, and probably from class to class in the same city; further, many points of information that were deemed important in a study of causes are not included in the registration records. The method adopted, therefore, was to supplement the registration records by inquiries covering type of feeding, earnings of father, color and nativity of mother, employment of mother, housing conditions, age of mother at birth, order of birth, maternal history, etc. With the results obtained it became possible for the first time in this country to study the effect of these various factors upon the mortality under one year of age.§

* Paper read at the seventy-ninth Annual Meeting of the American Statistical Association.

† Exclusive of Montclair, N. J., already published. In Montclair, the schedules were furnished by the Bureau, and the data tabulated, but the information was not gathered by the Bureau's agents.

‡ Sex of infant, single and plural birth, prematurity, age of mother, order of birth.

§ With the possible exception of the study made by the Bureau of Labor on Infant Mortality and its Relation to the Employment of Mothers, Vol. xiii of Report on Condition of Woman and Child Wage Earners in the United States, 61st Cong., 2nd Sess., Sen. Doc. No. 645. The Massachusetts statistics did not permit of anything more than unsatisfactory general correlations; the Fall River investigation was based on a study of deaths only.

An infant mortality rate expresses the probability of a live born infant dying before the first birthday per 1,000 live born infants. The usual approximate method of calculation is to compare all deaths in the city in a given year to all births in the city in the same interval—a method that is open to the objection that the deaths in the city may include some deaths of infants born elsewhere and some of infants born in the preceding year. When deaths and births are subclassified by race, nationality, economic status of father, etc., the effect of these inaccuracies becomes difficult to estimate. Accordingly the method followed by the Bureau in all of its studies has been to follow each infant born in a given selected year from birth till death or till the first birthday was reached. In this way, in theory, for each nationality or economic or other subclass a probability of dying in the first year of life is secured, each rate accurate and comparable with the other rates obtained.

In practice, however, difficulties arose. How were all births in the city in the year selected to be discovered? The obvious method was to search the birth records, and the facility afforded by these records was an important factor in the choice of cities to be investigated. But these records are faulty; in some cities a considerable percentage of births is not registered, in others only a few are omitted. Some evidence of faulty registration is given in the death records themselves; a death record may be at hand of an infant (born in the city) for whom no birth record is available. Records are probably more complete in a state like Massachusetts where certification is carefully checked every year than in a state where both the idea of registration is new and the officials have not learned the administrative methods necessary to secure complete registration. In the absence of a careful canvass it may be difficult to determine how complete the records of births are. Records of deaths are likewise often incomplete, though in general laws requiring death registration are more widely adopted and better enforced than those for birth registration.* If exactly the same percentage of deaths as of births is omitted, in each

*In Saginaw 3 deaths among 118 were found to have escaped registration; 149 births were added to 1,113 that had been registered.

class studied, the mortality rates will still be correct; but in most cases these percentages will not be identical, and usually the percentage of omissions of births will exceed that for deaths. In any case it is important to discover in what direction the errors in the mortality rates lie, and what procedure may best reduce or eliminate these errors or safeguard the conclusions.

In other words, the varying incompleteness of registration, which affects not only the general rate for the city but also the rate for each subclass and possibly also the comparability of these rates, is a serious difficulty. The question is put whether, by selecting a certain group for study, it would be possible to secure complete records for that group that would be somewhat more reliable than records for the city. The groups where the rates are most open to question and the facts most difficult to obtain are the births to migratory and non-resident mothers and the illegitimate births.

The migratory group where the family has moved away from the city is especially difficult to follow. Thorough and complete investigation would multiply the expense of inquiry, if indeed it were possible in all cases to find the mother to secure the information. It is certainly admissible to treat this migratory group separately; separate treatment seems especially advisable in view of the fact that the deaths in the group of infants born in the city and removed is not a complete tally because only the early deaths are certain to be registered. It would be interesting to know whether the fact that the family moved or that the family is a migratory one has any influence on mortality rates, but as yet the information secured has seemed so unsatisfactory that the results for this group have not been published.

One consideration upon which this policy of excluding migratory families was based was that the rates were to characterize the city; that housing conditions inseparable from geographical location, climate, etc., and especially local industrial, economic and social conditions materially affected mortality. Strictly speaking, the numerator of the fraction expressing the mortality rate should then include all deaths of infants in the locality, and the denominator the total number of years lived by all infants in the city. But in case of infants born else-

where, the mortality and health might depend upon or be influenced by conditions elsewhere, and the infants born to non-resident mothers might have either better or poorer chances of life due to conditions not peculiar to the locality. The inclusion of such cases among the deaths and the life time corresponding might therefore slightly influence the rates. In one class of cases in particular this influence would be marked; special hospital maternity cases, where infant mortality is considerably more than average, may include many non-resident mothers. Accordingly, to make the result as characteristic of the city as possible, all births to non-resident mothers were excluded. But in the main, the mortality rates are determined more by the type of feeding, economic class, etc., and the proportion of each class in the city, than by geographic and purely local climatic conditions.

A further reason for the exclusion or separate treatment of migratory families is the difficulty of securing an adequate statement of the years lived in the city. There are no data of the average age of infants moving away nor, for that matter, of the average age of infants moving in from the outside. If this information were available it would be possible to make monthly rates of mortality and to compare the monthly rates for migratory families with the rates where the family remained in the city.

A corollary of this policy of exclusion is that deaths in the city of infants born to mothers who later moved away prior to the visit of the agent have to be excluded. If not, the policy of exclusion would subtract only from the life time lived in the city without any deaths to correspond. A special class of cases is where the mother died. These cases are included if the infant or the family was living in the city at the time of the visit of the agent and excluded if the family had moved away.

The illegitimate births present certain special problems. There are difficulties in securing accurate information, for the families are frequently "non-resident" or have moved away. Nor are the data secured as trustworthy as for legitimate births. Furthermore, the conditions surrounding these infants are not those of the normal family, and these births should therefore be given separate treatment. In some cities no at-

tempt was made to secure schedules for the illegitimate births. In Baltimore the subject will be treated in a separate chapter.

The data presented then are reasonably complete and accurate for the legitimate births in the selected year to resident mothers living in the city at the time of the investigation.

For the rest, with migrant and non-resident and illegitimate groups excluded, three general methods of selection of the group are available. One is to take the records as they are, treating each death record as a birth record if the birth actually occurred in the city. The second is to take records of births as the starting point and accept records of deaths only when the birth record is available. The third is to supplement the records of births and deaths by a thorough canvass.

The three methods will give exactly the same results if the records are complete. If the records are not complete, the choice of method may be affected by the character and extent of the omissions. If death registration is complete but birth registration faulty, the first method will obviously give too high rates; if birth registration is nearly complete among the native but faulty among the foreign born, the method will exaggerate the differences between the infant mortality rates for the nativity classes.

The second method is an attempt to avoid the bias of the first method by the selection of births among whom the deaths are complete. The rates for each class of selected births are formed by comparing the number of infants that died (birth registered) with the sum of the infants that died plus those that survived the first birthday. These rates are correct in the sense that it is ascertained for each legitimate infant (of the resident group) whose birth was registered whether the infant survived or did not survive at the first birthday. Whether the rates are typical of the group is another and quite as vital a question; are enough infants that died associated with the infants that lived in each group to make a typical rate? Births in the more well-to-do families are more likely to be registered than in poorer families; the mortality rate for the group of infants selected on the basis of registration of birth tends, therefore, to be somewhat lower than the rate for all births. At first thought, it might appear that, in spite of this tendency

away from a rate typical of the entire group, the rates for each subgroup would be typical and allow of safe comparisons. But even here, the same tendency may show itself, the births in the more intelligent and better situated subgroups being more likely to be registered and therefore with fewer deaths among them to be associated with the registered births. Other reasons may affect the comparability of rates for these groups. If there is any connection between death of the infant and registration or non-registration of birth, the method will obviously give biassed rates. For example, if the physician on registering a death remembers and records the hitherto unrecorded birth; or if a doctor is called in case of an infant death shortly after birth where in case of survival for the first few days a midwife only is in attendance, the rate may be biassed; for the birth would be more likely to be recorded in case of death than if the infant survived the critical period of the first few days. But if the physician defers registration of birth and thinks it unnecessary if he has to record the death in a few days after birth, the rates will be biassed in the other direction. If these tendencies affect the well-to-do and poor differently or in different degrees, comparative rates may not tell the true degree of difference in rates between these classes. The method purports to be an unbiassed method of selection; it is unbiassed as far as personal or arbitrary bias of the investigator is concerned; but it may actually be biassed in favor of low rates for the entire group or for certain subgroups. It is therefore necessary even with this method to test the presence and determine the character of bias.

Several of the studies of the Bureau have been made on the basis of registered births: Manchester, Brockton, and New Bedford. An illustration of the effect of bias in the method of selection is afforded by Saginaw; the mortality rate for infants of foreign born mothers in the lowest income group came out approximately 50 per 1,000, nearly as low as the rate for infants of native mothers of the highest income group. When the infants that had been excluded on account of non-registration of birth were added the rate was much higher and more in accordance with what other studies have shown. Another peculiarity of the Saginaw material is the fact that

in the group of infants of foreign born mothers there were no deaths of infants aged less than 1 day reported. The usual percentage is about 15, and though the total number is small (only 20) the absence of deaths under one day is a trifle suspicious. That no stillbirths were reported by midwives may possibly be due to erroneous or neglected registration.

The third method assumes in absence of evidence that both birth and death records are likely to be deficient and attempts by the best methods available to remedy the deficiencies. Whether all births and deaths would be discovered would depend on the scope and carefulness of the canvass.

In a word, the first method usually errs in overstating the mortality rate; the second and third methods attempt to secure more accurate rates, the second by selection of births and the third by supplementing the data.

The choice of method is frequently limited by the practise of the registration office. In Waterbury and Baltimore, for example, if an infant death was recorded where the birth had occurred in the city, the birth was immediately recorded if not previously registered. The distinction here, between the first and second methods, became impossible to make. In several cities, therefore, and especially in those cities with faulty birth registration, the records have been supplemented by a canvass or in other ways. In Saginaw, 149 live births were added to total of 1,113 even without a systematic canvass, by use of baptismal records and neighborhood inquiry. In Waterbury, 329 unregistered live births were added to the 2,239 registered. In Akron (outside of the birth registration area), a canvass was obviously necessary. In Baltimore, a campaign for complete birth registration by all the civic and social agencies was being conducted during the progress of the infant mortality study with the result that many births were added.* The tendency, therefore, has been to resort to the method of supplementing official records by a canvass.

In this connection the exclusion or separate treatment of migratory families is the more justified because it fits in with the plan of securing additional information by a canvass and

* In Brockton and New Bedford a canvass is made by special state agents to correct registrations; additional births discovered are added to the registered births.

simplifies the problem very greatly. If the group to be studied includes only cases where the infant is born in the year selected and the family is living in the city at the time of the canvass it becomes at least possible with a thorough canvass to locate all births and deaths that ought to be included. The death records need be supplemented only by deaths of infants born to mothers who are still living in the city, normally these deaths will be recorded. The birth records are to be supplemented by the addition of any children living in the city at the time of the canvass, who were born in the city in the selected year. Of course some difficulties still exist. But in the main the procedure is simple and the data for this "canvassable" group are reasonably complete and accurate.

In any of these methods there arise interesting and often perplexing problems of identification. Sometimes an infant's name is spelled in one way on the birth certificate and in another on the certificate of death.* The phonetic spelling of the name by the doctor who makes the return may not agree at all with the spelling preferred by the family of the child. These cases are fairly common among the foreign groups, especially with the perplexing names of Poles and Lithuanians. It is sometimes difficult to locate families even when they have not moved, as in one section of Waterbury where the foreigners —this is a free country indeed—chose lucky numbers for their houses. Families that move once or twice to other places within the city are often hard to locate because neighbors do not always remember the new address. If a canvass of the city is made these families are found at the correct addresses by the canvassers.†

Turning to the analysis of results, in the Baltimore material we have for the first time in these studies a large enough number of colored infants to give a significant mortality rate. The rate for white infants is 95.9; for colored, 158.6, or 65 per cent higher.‡ The foreign born in Baltimore have the same rate as the native; but analysis of the foreign born group show

*For example, Zartsch and Sage, Greenwood and Boisvert.

†There are always a few cases that can not be traced, for whom it can not be determined even that they have moved away. These cases are omitted, the chances being that they belong rather to the migrant than to the resident group, especially if a canvass is made and fails to locate them within the city.

‡All figures for Baltimore are provisional.

striking differences among the different nationalities, differences that have been revealed in other studies. The Hebrews have the remarkably low rate of 51.0, the Poles, on the other hand, the high rate of 163.2.

For fathers' earnings groups the rates decrease from the rate (maximum) of 156.7 for the group with earnings under $450 to 37.2 (minimum) for infants whose fathers earned $1,850 or over.

TABLE I.
INFANT MORTALITY RATE BY FATHERS' EARNINGS.

Earnings of Father	Infant Mortality Rate	Live Births	Deaths
All classes	103.5	10,797	1,117
Under $450	156.7	1,544	242
$450–$549	118.0	1,449	171
$550–$649	108.8	1,489	162
$650–$849	96.0	2,417	232
$850–$1,049	71.5	1,595	114
$1,050–$1,249	66.6	661	44
$1,250–$1,449	74.0	419	31
$1,450–$1,849	86.3	371	32
$1,850 and more	37.2	431	16
No earnings	207.7	207	43
Not reported	140.2	214	30

The effect of the kind of feeding can be discussed intelligently only in connection with the age of the infant in intervals of less than a year because of the changes in the proportion of infants artificially fed at different ages. In the following chart for Baltimore the monthly death rates are shown for artificially fed and breast fed infants and the probability of dying in the month is given for all infants except those not fed. The rates for the artificially fed are from three to nine times those for breast fed infants. The relative percentage disparity between the rates is greatest from the third to the eighth months and is greater for these than for the first month. In this respect the figures agree with the data for Berlin for 1895–96, though there the rates for the artificially fed were considerably higher than in Baltimore.

Besides the two main groups there is a group of infants with mixed feeding. The rates for this group lie midway between the rates for the other groups; for the first month it is nearly equal to the rate for the artificially fed, but for later months it approximates more closely the rate for breast fed infants. For all of these groups the type of feeding taken is that for the major part of the month, or, which amounts to the same thing,

TABLE II.

MONTHLY PROBABILITY OF DYING PER 1,000 SURVIVING AT BEGINNING OF SPECIFIED MONTH OF LIFE AND MONTHLY DEATH RATES BY TYPE OF FEEDING IN BALTIMORE, 1915.

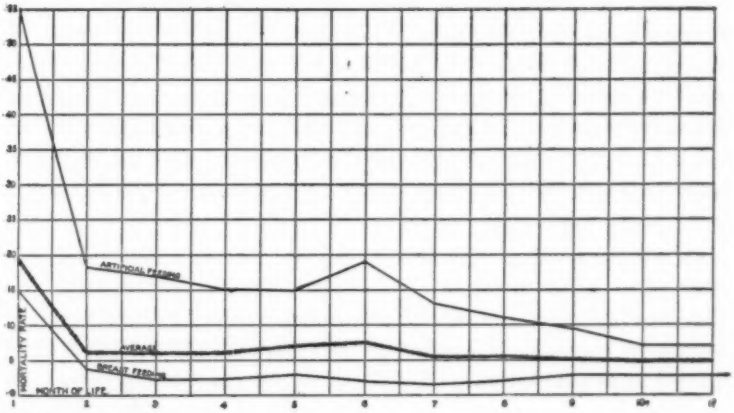
Month of Life	All Infants	Breast Fed	Mixed	Artificially Fed	Relative Difference*
1.....	(44.1) 19.8†	15.0	42.7	55.3	3.7
2.....	6.3	3.8	4.9	18.9	5.0
3.....	6.1	2.4	9.5	17.0	7.0
4.....	6.1	2.3	5.2	15.3	6.6
5.....	7.0	3.0	5.6	15.1	5.0
6.....	7.6	2.1	4.0	19.1	9.1
7.....	5.6	1.7	3.2	13.0	7.7
8.....	5.6	2.2	3.3	11.2	5.1
9.....	5.2	2.8	3.1	9.5	3.4
10-12.....	14.3‡	8.2‡	7.0‡	28.8‡	3.5

* Relative difference between artificial and breast feeding, column 4 divided by column 2.

† Figure is for probability of dying for infants who lived long enough to be fed, the figure in parentheses is the probability of dying for all live born infants.

‡ Figures are, first column, probability of dying before end of year per 1,000 infants surviving at beginning of the tenth month; second to fourth columns, deaths in tenth to twelfth months per 1,000 infants at risk at beginning of period

CHART I. MONTHLY PROBABILITY OF DYING IN THE FIRST YEAR OF LIFE, AND MONTHLY DEATH RATES BY TYPE OF FEEDING.*



* Figures in Table II.

for the middle day of the month. The number of infants that died breast fed is therefore divided by the approximate number of months lived by breast fed infants for the month of life considered, giving a monthly death rate for this type of feeding.*

* The information for infants for whom the type of feeding changed during the month is scarcely so accurate as suggested in the discussion. The above treatment would give the correct result if the data were gathered in every case according to instructions. In cases where instructions were not followed, the above treatment would be as safe as any. Such cases would form a relatively small proportion of the total.

TABLE III.

DEATHS PER 10,000 LIVING AT EACH AGE ACCORDING TO TYPE OF FEEDING: BERLIN, 1895-96.*

Age in Months	Breast Milk	Cows' (and Goats') Milk	Column 2 Divided by Column 1
0	201	1120	5.6
1	74	588	7.9
2	46	497	10.8
3	37	465	12.6
4	26	370	14.2
5	26	311	12.0
6	26	277	10.7
7	24	241	10.0
8	30	213	7.1
9	30	191	6.4
10	31	168	5.4
11	39	147	3.8

* Except last column, from Westergaard, H., *Die Lehre von der Mortalität und Morbilität*, 2nd Ed., Jena, 1901, p. 361. Results of Böckh for Berlin, based on census of infants in city (.2 unknown) and death certificates—(exclusive of infants who died in first day, the type of feeding was unknown in one seventh of deaths, for 1896, these were distributed pro rata of known cases.)

The results of the table for Baltimore may be stated in other words. If the rate for the artificially fed had been the same as that for the breast fed infants, only 92 instead of 437 deaths would have occurred among the former group. The rate for breast fed was only 21.3 per cent. of that for the artificially fed on an average. If all the infants had been breast fed and the same rate had applied to all as characterized the breast fed infants the total deaths of the group studied would have been reduced by 345, from 1,117 to 772, the rate from 103.5 to 71.5 per 1,000 live births.

Of course some of the artificially fed babies may be weaker than their more fortunate brothers. One might assume the effect of such weakness, if it necessitated artificial feeding, would be especially marked in the first month of life. But the relative difference in the rates is greater for the third and later months than for the first and second. Light may be thrown on the effect of continued artificial feeding and of a shift of feeding by an analysis of mortality rates by duration of each type of feeding.

Analysis of mortality rates for each type of feeding by economic conditions might reveal clearly the effects of other elements in mortality. As far as nativity of mother is concerned the evidence shows in most cases that a larger proportion of native mothers than of foreign born mothers feed their infants artificially. The differences between the average rates for the

two groups, therefore, is somewhat minimized by neglecting to make a secondary analysis by nativity classes. A difficulty in interpreting the results of such a secondary analysis, however, is that artificial feeding does not always have the same implications. The native mother may be more careful in preparation of the cows' milk for the baby, she may make use of the formulae for modifying the milk that insure the best results. This difference in the meaning of artificial feeding for the nativity groups must be taken into consideration in interpreting the conclusions.

Another problem is the question of the effect upon mortality of employment of the mother in the year following the birth of the infant. It has been shown that a relatively small percentage of mothers are gainfully employed away from home. In Baltimore, mothers of 859 infants, or 8.0 per cent. of the total, were employed away from home during the lifetime of the infant. In Waterbury only 3.4 per cent. of the infants had mothers so employed, an even smaller proportion of the total. The general mortality rate for the city could not be primarily influenced or much affected by a high mortality among infants whose mothers were gainfully employed. It is quite possible, however, that gainful employment of the mother away from home may increase considerably the mortality rate *among the infants of these mothers.* To determine this effect it is necessary to know the age of the infant at the time the mother went to work.*

In Baltimore, of these 859 infants whose mothers were gainfully employed away from home, 78 died. If the rate for all infants had been applied to these infants at the ages at which the mothers went to work only 39 deaths would have resulted. In other words the mortality rate of infants whose mothers were gainfully employed during the lifetime of the infant was about twice the average rate.

Further analysis might determine whether this excess mortality was due merely to the necessity of artificial feeding or to the preponderance among the group of infants of colored mothers or of infants in the low income groups. If gainful

* If the infant died before the mother went to work or resumed employment, the death can not be attributed to the employment of the mother.

employment of the mother involves artificial feeding the mortality among the infants would normally be high; artificial feeding, however, may not be sufficient to account for the difference. If a large majority of those gainfully employed were colored, one would expect more deaths than if the mothers were white; and similarly if a large proportion were in the relatively poorer classes, as undoubtedly was the case. Extended analysis may indeed show, as suggested by Hibbs,* that the earnings of the mother, by providing means for extra care and somewhat better conditions, may more than make up for the handicap under which the infant suffers through absence of the mother during work hours. By calculating the deaths that would have occurred among the infants of mothers gainfully employed for each such group at the rate for the subgroup (colored, white, poor, well-to-do, etc.), applied to the corresponding numbers in it, first with the rate for breast fed infants and then with that for artificially fed infants, it would be possible to show how much handicapped these infants are by reason of not being breast fed and how far, if at all, they are favored over the artificially fed infants of mothers who are not gainfully employed.

These studies throw light upon the connection between the death of the mother and infant mortality. It is to be expected that when the infant is deprived of the mother's care the mortality would be higher. In Waterbury there were 16 live births to mothers who died during the year following confinement. At the average rate of mortality for the city (122), two deaths would have occurred among them but actually six deaths occurred, or three times as many. In Baltimore there were 68 live births to mothers who did not survive the next year. At the average rate for the city 7 deaths would have occurred; there were actually 34 deaths or nearly five times as many.†

A very interesting fact is brought to light in examining the proportion of families of a given number of births that had no

* But not demonstrated; the figures quoted are for the Johnstown report of the Children's Bureau, in which no analysis is made of the age of infants at the time of the mother's resumption of employment. The figures then merely compare infant mortality in families where the mother works with that in families where the mother is not employed; this comparison is an essentially different proposition and is not so directly related to the problem. Hibbs, Henry H., Infant Mortality: Its Relation to Social and Industrial Conditions, p. 108.

† Cf. Westergaard, H., *Die Lehre von der Mortalität und Morbilität*, 2nd. Ed., Jena, 1901, p. 376.

infant deaths. In families of two births if the mortality rate is 100 or one in ten die, the probability that both children die before the end of the first year is one in 100, and that both children survive the first year 81/100. Similarly for families of n births, if q is the probability of surviving the first year, q^n is the proportion of families where all infants survive. A comparison of the actual and expected rates as so calculated reveals the interesting fact that there are more families with no deaths than would be expected by the laws of chance: in other words the deaths are found to be slightly concentrated in relatively few families. That this result is not strange follows directly from the consideration that when the care given by the mother is unusually good, or when the physique inherited by the infant safeguards him through his first year of life, it is likely that his later brothers and sisters will enjoy the same advantages as he. The occurrence of infant deaths among the later births is not entirely independent of the causes leading to deaths among the earlier births in the same families.

A study of the effect on mortality of the interval between births is permitted, though not as directly as might be wished, by a classification of births by age of mother and order of birth. Where the mother is under 20, and two or more births have occurred, it is highly probable that the interval between births has been short; by a combination of age of mother and order of pregnancy, it appears that the rates for the later numbers in order of pregnancy advance rapidly, and always more rapidly the younger the age of the mother in the group considered. For third births, for example, the rate is 196 for mothers under 20, 129 for mothers 20–24, 99 for mothers 25–29, etc. For fifth births it is 184 for mothers 20–24, 134 for mothers 25–29, and 95 for mothers 30–34. Of course it is possible that a subclassification by color or economic conditions might explain some of those differences.

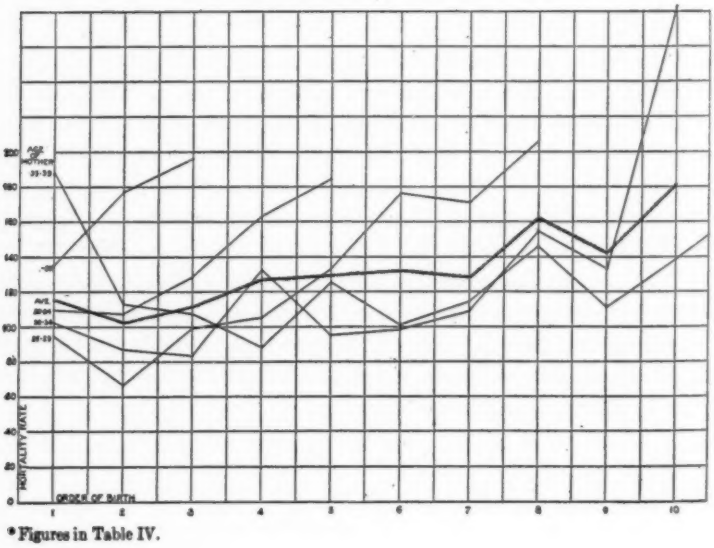
TABLE IV.

MORTALITY RATES BY AGE OF MOTHER AND ORDER OF BIRTH: BALTIMORE.*

Number in Order of Birth	Average	Age of Mother					
		Under 20	20–24	25–29	30–34	35–39	40 and Over
Average		148.1	118.6	107.7	112.8	126.7	131.2
1	115.8	135.1	109.8	95.1	102.4	(188)	.....
2	102.7	177.2	107.5	66.8	87.0	113.2	.....
3	111.5	196.4	128.7	99.4	83.5	107.6	.....
4	127.0	(290)	163.4	105.1	132.4	88.4	.....
5	129.3	.....	184.0	133.6	95.4	125.5	.....
6	132.2	.....	(179)	176.7	98.2	101.1	.....
7	128.2	.....	.....	171.6	108.7	114.5	.....
8	162.6	.....	.....	203.7	154.5	146.1	.....
9	142.1	.....	.....	(295)	133.0	111.1	.....
10	181.1	.....	.....	.....	282.3	138.4	.....
11	146.8	.....	.....	.....	.....	152.4	.....

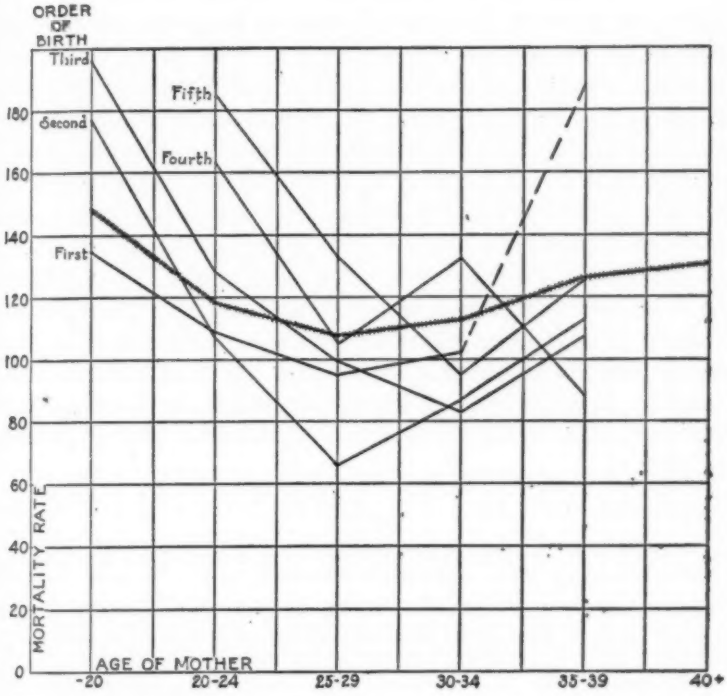
* Includes all births reported by mothers of infants born in Baltimore in 1915.
Rates bracketed based on fewer than 100 cases. Rates for twelfth and later births omitted.

CHART II. GRAPHS FOR EACH AGE-OF-MOTHER GROUP SHOWING VARIATION IN INFANT MORTALITY RATES BY ORDER OF BIRTH.*



* Figures in Table IV.

CHART III. GRAPHS FOR EACH ORDER OF BIRTH SHOWING VARIATION IN INFANT MORTALITY RATES BY AGE OF MOTHER.*



*Figures in Table IV.

The effect of lack of proper spacing between births can be studied by analysis of mortality rates for families of different sizes (number of births to mother) and average duration of married life. That the interval between births is short is obvious when the "terms" of married life are short and the number of births is relatively large; but for long durations of married life it is uncertain whether births have been properly spaced or not.

The results for Waterbury are shown in the accompanying table, giving the mortality rates for infants of mothers married less than 6 years, 6 to 10 years, 11 to 15 years and 16 years and over. In the first three groups the tendency is marked for the

rate to increase as the interval, indicated by a large number of births, decreases.

The second table is an attempt to group the results more clearly in terms of the interval between the birth and the beginning of the succeeding pregnancy. The rates where the average interval between the birth of one child and the next pregnancy is approximately 1 year is considerably higher than where the interval is approximately 2 years or 3 years or over, 151.4, 111.2, and 102.3 respectively. An interesting feature of the table is the decided increase in the rate as the number of successive births following one another by intervals of less than 2 years increases. That the result is not explained by the increase in size of family alone is indicated by the fact that in large families where the average interval is over two years there is but little difference in rate from that for the smaller families. One might fairly conclude that an important cause of high mortality is the lack of proper spacing of births.*

TABLE V.

MORTALITY RATES BY LENGTH OF MARRIED LIFE AND NUMBER OF BIRTHS TO MOTHER: WATERBURY.

Number of Births	Length of Married Life											
	5 Years and Under			6–10 Years			11–15 Years			16 Years and Over		
	Live Births	Deaths	Rate	Live Births	Deaths	Rate	Live Births	Deaths	Rate	Live Births	Deaths	Rate
1...	469	47	100.2	11	0	0.0	...	..	.....	...	..	.....
2...	656	61	93.0	153	18	117.6	26	2	(77)	2	0	.....
3...	510	73	143.1	408	38	93.1	54	4	(74)	15	1	(67)
4...	146	28	191.8	676	82	121.2	157	16	101.9	46	6	(130)
5...	15	5	(333)	552	83	150.4	355	32	90.1	71	7	(99)
6...	...	..	.....	255	48	188.2	429	43	100.2	83	5	(60)
7...	...	..	.....	98	20	(204)	398	46	115.6	200	34	170.0
8...	...	..	.....	21	4	(190)	280	47	167.9	250	41	164.4
9...	...	..	.....	9	0	0.0	137	31	226.3	209	32	119.0
10..	...	..	.....	...	..	.....	60	19	(317)	314	49	156.1
11..	...	..	.....	...	..	.....	11	5	(455)	135	24	177.8
12..	...	..	.....	...	..	.....	12	8	(667)	140	24	171.4

Rates for 13 and over omitted.

* Part of the differences in rates may be due to the tendency for the interval between births to be shortened in case of death of an infant. See page 47.

TABLE VI.

MORTALITY RATES BY APPROXIMATE AVERAGE INTERVAL BETWEEN BIRTH AND NEXT PREGNANCY BY NUMBER OF BIRTHS TO MOTHER: WATERBURY.

Number of Births	Average Interval 1 Year				Average Interval 2 Years				Average Interval 3 Years or Over			
	Years Married	No. Live Births	Deaths	Rate	Years Married	No. Live Births	Deaths	Rate	Years Married	No. Live Births	Deaths	Rate
2.....	1– 4	590	55	93.2	5–6	141	14	99.3	7+	106	12	113.2
3.....	1– 6	660	81	122.6	7–9	229	25	109.2	10+	98	10	(102)
4.....	1– 7	562	89	158.4	8–11	307	26	84.7	12+	156	17	109.0
5.....	1– 9	486	78	160.5	10–14	411	47	114.4	15+	96	8	(83)
6.....	1–11	356	57	160.1	12–17	357	36	100.8	18+	54	3	(56)
7.....	1–13	392	54	137.8	14–20	246	25	101.6	21+	28	1	(36)
8.....	1–14	237	41	173.0	15–22	325	45	138.5	23+	19	6	(316)
9.....	1–16	189	34	179.9	17+	222	29	130.6	....	...	..	.....
10.....	1–18	217	49	225.8	19+	157	19	121.0	....	...	..	.....
11.....	1–20	74	20	(270)	21+	72	9	(125)	....	...	..	.....
12.....	1–21	82	24	(293)	22+	77	8	(104)	....	...	..	.....
2-12....	...	3,845	582	151.4	.....	2,544	283	111.2	....	557	57	102.3

Rates for 13 and over omitted; (6 mothers) 16 deaths, 77 live births.

A third method for the study of the effect of interval between births is available but hitherto not used. The schedules gathered show usually the age of the infant born in the selected year at the commencement of a later pregnancy as well as a rough statement of the interval between the birth of the child in the selected year and the preceding birth. By analysis of these it may be possible to determine the effect on mortality of the child following another by a short interval as well as of the child preceding another by a short interval: the effect in the two cases may be of different character and of different magnitude. By excluding infants that died before the commencement of next pregnancy, this method of procedure would have the obvious merit of eliminating the effect of a tendency, revealed in European statistics, for the interval between successive births to be shortened in case of the death of an infant at an early age.*

There remain two very important problems of treatment of data, both of which have been suggested in the foregoing.

One is the problem of determining how many cases suffice to establish a conclusion. In the example cited, p. 42, is the fact that 34 deaths occurred, instead of 7 expected, among the 68

* Cf. Westergaard, H., *Die Lehre von der Mortalität*, 2nd ed., pp. 370–1.

live births a sufficient basis for a conclusion that the death of the mother exercises an adverse effect on infant mortality? The problem may be stated in slightly different words: is the result due to a significant cause or causes or is it to be explained merely as a chance combination of insignificant or unimportant causes? If we can show that it is not explicable on ground of "chance combination of individually unimportant causes," we have taken a long step toward establishing the true causal connection, though it may or may not be true that the cause alleged is the important factor.* The procedure is simply to calculate the probability or improbability of the result occurring by chance, by analogy with the results of games of chance.

The proposition might be put as follows: If black and white balls are mixed in an urn in the proportion of 103 black to 1,000 total (the mortality rate in Baltimore was 103) and 68 are drawn at random, the most probable number of black balls would be 7. How frequently would 34 or more of the balls be black? It is easily seen and it can be mathematically shown that such a result is extremely improbable—it would occur but a few times in a million drawings. One may conclude, therefore, reverting to the problem under discussion, that some significant causes are acting to increase the mortality of infants in cases where the mother died, that there is a causal connection between the two.

The mathematical formula for the root mean square error (or, if preferred, the probable error) may be used to test the probability of a result occurring from a chance combination of of insignificant individual causes in connection with the differences between the observed and expected results. A deviation of three or four or more times the standard or mean error makes it practically certain that real causes are acting.†

The number of cases necessary to establish a conclusion depends (a) on the probabilities involved, and (b) on the amount of the differences between observed and expected results.

The second problem is that of separating the effect of two or

* Compare the discussion on the effect on mortality of gainful employment of mothers, p. 41.

† The applicability to mortality rates of this procedure of comparison by analogy with results of game of chance has been discussed by Westergaard and others. Cf. Westergaard, H., *Die Lehre von der Mortalität*, 2nd Ed., pp. 186 ff., esp. 197–9. *Die Grundzüge der Theorie der Statistik*, ch. 5. Scope and Method of Statistics, Quarterly Publications, American Statistical Association, Vol. XV, pp. 244 ff., Sept., 1916.

more interrelated factors and assigning to each its proper and due weight. The problem may be made more concrete by discussion of some specific cases, for example, age of mother and order of birth, or race and earnings of father.

The heavy lines in the charts show the variation in infant mortality by age of mother and by order of birth separately. But it is possible that the high rates for mothers over 40 is due to the large proportion of births of late orders to such mothers —births, among whom the mortality rate is high, or vice versa. How can these effects be separated?

Various methods have been suggested, the correlation coefficient, multiple correlation, some method of standard distribution, and Westergaard's method of expected and actual deaths.

Analysis of the problem shows that the method to be preferred depends upon the amount of information available. The object sought may be either to sum up in easily understood form the data of a complex table, or it may be to add to the information at hand by further analysis.

Suppose, for example, that infant mortality rates are at hand for various cities and that nothing is known of mortality rates for infants of native and foreign born, of illiterate and literate mothers, of mothers employed and not gainfully employed. Some light may be thrown on the relationship by securing indices of these factors for the different cities and classifying the cities by the size of the indices and average mortality rates, in other words by correlating mortality with the various indices. It will be readily admitted that the conclusions are likely to be precarious, first, because comparatively few cities may be used, second, because indices may not be very directly related to the problem investigated, and thirdly because important factors may be overlooked. A correlation may be found between infant mortality rates and the percentage of foreign born, which may be due solely to the poor registration of births in cities with a large percentage of foreign born. Where complex relationships, such as between the mortality rates and age of mother and order of birth, are investigated by this method, the selection of a true index becomes almost impossible, especially in case the relationship is not linear. Yet in absence of

classified births and deaths, such a method of analysis may be better than nothing.

A second case is where it is sought by further analysis to determine which of two factors is the more important causally and to determine the limits of the effect of each. This problem appears in two forms: where the only available information is a series of rates for each factor separately, and where rates are given for each combination of both factors. In the latter case the problem is one of combining results and presenting the significant conclusion. But in order to determine the method of approach and the possibilities of analysis where only part of the information is available, it will be pertinent to give a few illustrative cases where conclusions based on partial data may be tested by the fuller information.

One difficulty in the interpretation of average rates for each factor separately is that the average may be influenced by the special distribution of births in each group. A second difficulty is the interpretation of causality. In the example under discussion it is probable that neither age of mother nor order of birth are per se "causes," but simply that they connote or imply conditions that favor high mortality—impaired physique, or lack of experience. Low age of mother may obviously connote a low order of birth. To the extent that one connotes the other, one is as significant as the other, except that one may be shown to be more directly related to the true cause. All that statistical analysis can show at best is the extent to which each factor connotes something not connoted by the other, and the extent to which both factors have the same connotations.

CASE I. FACTORS INSEPARABLE.

(1,000 births assumed in each group where rate is shown.)

Age of Mother	Order of Birth.					
	Average	1	2	3	4	5
Average		100	110	120	130	140
20	100	100				
22	110		110			
25	120			120		
32	130				130	
38	140					140

CASE 2. AGE OF MOTHER SOLE CAUSAL FACTOR.

Age of Mother	Order of Birth					
	Average	1	2	3	4	5
Average		105	110	120	130	135
20	100	100				
22	110	110	110	110		
25	120		120	120	120	
32	130			130	130	130
38	140				140	140

CASE 3. ORDER OF BIRTH SOLE CAUSAL FACTOR

Age of Mother	Order of Birth					
	Average	1	2	3	4	5
Average		100	110	120	130	140
20	105	100	110			
22	110	100	110	120		
25	120		110	120	130	
32	130			130	130	140
38	135				130	140

CASE 4. BOTH FACTORS INFLUENTIAL.

Age of Mother	Order of Birth					
	Average	1	2	3	4	5
Average		105	120	140	160	175
20	105	100	110			
22	120	110	120	130		
25	140		130	140	150	
32	160			150	160	170
38	175				170	180

The average rates for the different orders of birth and for the different ages of the mothers show the same general trend in all four cases. It seems clear from a study of these examples that where merely the averages are given it is impossible to determine the relative effect of each factor.*

* Size of correlation coefficient appears to be inconclusive, if only averages for each factor are available.

If in addition to the average rates the distribution of births classified by both factors is given, it may be possible to throw some light upon the relative influence of each cause.* Perhaps the most satisfactory method is that suggested by Westergaard of calculating deaths on the assumption first of a uniform rate for each order of birth, and then for each age of mother, comparing the calculated with the actual deaths to determine the trend of the true differences. The method has its limitations. But applied to the cases given above, it indicates correctly (except for the first, which is indeterminate) which is the true causal factor, though perhaps minimizing its effect. The method is applicable even if the relationship between the rate and either or both factors is not linear. If another cause, such as interval between births, is more important than one of the factors under discussion the result is of course inconclusive to the extent that this cause has been disregarded.

If in addition to births the deaths are also subclassified, it becomes possible to give rates for each subgroup and to determine definitely the causal influence of each factor. The problem here is to combine the results in some easily understood form that epitomizes the data, showing the true weight of the causes considered. But for the statistician nothing can quite replace the rates themselves. For if some other cause is of considerable importance besides those presented, a summary process may obscure its effect and lead to erroneous conclusions. In the case under examination it becomes evident from the study of the charts showing the variation of rates for each order of birth by age of mother that the interval between births affects the mortality rates by age.

If the two factors are the only important ones to be considered, and the object is merely to present a result not affected or warped by a peculiar distribution of births, the best method is probably some form of the method of standards. For example, the difference between the rates for colored and white is somewhat exaggerated by the large proportion of colored in the lowest economic group. It is possible to present the true

*The character of the distribution of births often permits of approximately correct conclusions from the averages of two factors; it is where the distribution is "warped" that the conclusions need to be corrected. The method of a standard distribution is merely a substitution of a symmetrical for a "warped" distribution.

difference between colored and white either by calculating deaths in a *standard population* by applying first white and then colored rates: the sum of the deaths divided by the population gives the standardized rates. But it is rather better to use the actual distribution of population in the group as the *standard itself;* and calculate the deaths that would have occurred among the colored population if the rates prevalent among the white population had applied. The advantage of this method is simply that undue weight is not given to those rates which are based on relatively few cases, and that it is possible to present the number of cases upon which the rates are based so that the standard error may be calculated.

STATISTICAL WORK IN THE OFFICE OF THE SURGEON GENERAL OF THE ARMY.

By HORATIO M. POLLOCK, PH.D., *Statistician, New York State Hospital Commission.*

The statistics prepared in the office of the Surgeon General of the Army are of three kinds, namely:

I. Current statistics relating to the disease conditions of the army.

II. General vital statistics of the army.

III. Special statistics dealing with the work of experts recently called into the service.

I. CURRENT STATISTICS.

The office receives weekly telegraphic reports relative to diseases and deaths and general health conditions from each of the army camps, and a consolidated report from each of the departments; the department reports comprising all posts that do not report to the War Department direct. The information thus received is tabulated on a special form, and ratios are made for admissions to sick report and noneffectives and for the various diseases. A consolidated report is then prepared for the camps of the National Guard and the National Army. These reports are brought together and consolidated with the combined reports of the departments making a general report for the army as a whole. From these general reports a weekly statistical letter headed "Diseased Conditions Among Troops in the United States" is prepared. The figures for each division are entered week by week upon a form specially prepared for such purpose. This shows the variation of the weekly rates in the separate divisions. From these a combined form is prepared each week showing the rates for all the divisions. This furnishes the basis of comparison of the different divisions by weeks. From these data, charts are prepared for each division showing the admission and noneffective rates from week to week, and consolidated rates for the different infectious diseases in the National Guard, National Army and Regulars. This work furnishes a current statistical index of health condi-

tions in the various camps and departments, and constitutes an important factor in health regulation in the different divisions of the army.

II. GENERAL VITAL STATISTICS.

The general vital statistics of the army now being compiled in the Surgeon General's Office are similar to those published in the Surgeon General's annual reports for many years. The increase in the size of the army, however, has necessitated a change in the method of handling the statistical material. The basis of the statistics here prepared is a schedule report card known as Form 52. This form gives detailed information concerning every case admitted to sick report that receives treatment for any conditions of importance. The information from these cards was formerly tabulated by hand methods. On account of the increased volume of the business a coding book and corresponding punch cards have been prepared and the data will be transferred to such cards and tabulated by machines.

The preparation of the coding book involved a revision of the classification and nomenclature of diseases and traumatisms. The classification of diseases previously used in the medical department of the army was the one known as the "Bellevue Classification." This classification, while an improvement on the classifications that preceded it, was unsatisfactory in many respects. With reference to nervous and mental diseases the coding book follows the classification already in use in the new division of neurology and psychiatry; the classification of mental diseases being the same as that adopted by the American Medico-Psychological Association at its meeting in New York in May, 1917. The new classification of traumatisms is very complete and its use will result in giving more detailed information concerning wounds than have previously appeared in our army reports.

III. SPECIAL STATISTICS.

The statistical work in the new divisions of the Surgeon General's Office may be illustrated by reference to the division of neurology, psychiatry and psychology which was organized under the direction of Major Pearce Bailey.

This division is separated into two sections, one dealing with neurology and psychiatry, the other with psychology. The work of the first section consists of two principal lines of activity: the examination of troops for the detection of nervous and mental disease and defect, and the care of the soldiers who become mentally ill. Up to the present time the work of examining has been the principal function of the section, but when active fighting begins the number of mentally ill to be cared for will probably assume large proportions.

As this division, like several others in the Surgeon General's Office, was organized after the entry of the United States in the war, and as neurological and psychiatric examinations of troops had never before been attempted on a large scale, there existed no system of records that would furnish an adequate accounting of the work performed or results accomplished. In the beginning examiners were sent to the various army reorganization camps and to the headquarters of the divisions of the National Guard in several states, and were instructed to send reports of the work performed to the Surgeon General's Office. The inadequacy of such reports was soon apparent. After a careful survey of the whole situation a system of records was adopted which it is hoped will ensure fairly uniform procedure on the part of examiners and reliable reports so classified that they may be combined, and desired information obtained therefrom.

Having in mind the necessity of keeping army records as simple as possible, three blank schedules were prepared. First, a form for the record of the neurological and psychiatric examinations. This blank contains a brief outline of the points to be covered in the examinations, and the order to be observed in reporting findings. The purpose of this form is to supply a definite record of the findings of the examiner that could be checked up by an expert in the office and finally be filed with the soldier's papers. Second, a statistical data card calling for certain facts concerning each case examined that was found to have nervous or mental disease or defect. The card provides for a specific diagnosis under one of the following heads: nervous disease, psychosis, psychoneurosis, constitutional psychopathic state, inebriety, and mental defect; together

with data concerning the soldier's age, residence, race, nativity, economic condition, previous environment, previous diseases, army service, wounds and injuries, and family history. These blanks serve two important purposes: they form an adequate record and they require close study of cases by examiners. The third blank calls for a general numerical report to be submitted monthly by the senior medical examiner at each station. This blank calls for the organizations examined, the strength of command and a summary of examinations and disposal of cases. These reports give a general view of conditions in this field at each station and enable the statistician to compare the nervous and mental cases found with the total examined and the strength of command at the several stations.

The plan has nothing remarkable about it except its newness, it being the first effort on the part of our army authorities to conduct and record special examinations to determine the nervous and mental status of soldiers. The system of reports of examinations here outlined went into effect October 1, 1917, and reports for only two months have been received. Thus far from one to three per cent. of the men examined have been found to be mentally diseased or defective.

The section in psychology is engaged in testing the intelligence of troops at various cantonments, the purpose being to weed out those who are incapable of understanding orders and to discover those who possess superior intelligence. The latter, if otherwise capable, would naturally be assigned to responsible and difficult work. Major Yerkes and his assistants in this section have prepared an effective system of tests and records which enable the examiners to perform their work with accuracy and dispatch. The point scale of marking is used, and the relative standing of the men can be seen at a glance from the final rating sheet. In the early tests it was found that from two to six per cent. of the men were of a high order of intelligence and from three to five per cent., mentally deficient.

Each of the other new divisions in the Surgeon General's Office is compiling statistical records of its special work.

The results when finally brought together will constitute a remarkable chapter in medical and military annals.

VISITING NURSING AND LIFE INSURANCE.

Statistical Summary of Results of Eight Years of Public Health Nursing for Industrial Policyholders of the Metropolitan Life Insurance Company, New York.

By Lee K. Frankel, Ph.D.
and
Louis I. Dublin, Ph.D.

INTRODUCTORY.

The Visiting Nurse Service for policyholders of its Industrial Department was instituted by the Metropolitan Life Insurance Company in June, 1909. At first it was experimentally introduced in New York City. The results soon warranted an extension of the service to other cities. It has been opened up systematically as local facilities permitted, so that at the close of 1916 it was available to over 90 per cent. of the ten and one-half million policyholders in the Company's Industrial Department, in about two thousand cities and towns in the United States and Canada. In the year 1916, 217,422 cases received nursing attention and over one million visits were made. Such has been the growth of a public health activity modestly begun only a few years ago, indicating the great public need for such work. This report presents fully the statistical history and the present status of the visiting nurse service of the Company. It considers the facts of its growth and gives details of its accomplishments as part of the public health movement in the United States and Canada. It is hoped that this account may prove of value to those engaged in public health work, and that it may serve in the effort to standardize visiting nursing activities.

GROWTH OF THE SERVICE.

The following table shows the growth of the service in the number of cases under care, the number of visits, total cost of the service, and the number of cities and towns included in its operation for each of the fiscal years of operation since 1909.

TABLE I.

NUMBER OF CASES AND VISITS, CITIES AND TOWNS SERVED—TOTAL ANNUAL COST—VISITING NURSE SERVICE, FISCAL YEARS 1909-1916.

Year	No. of Cases	No. of Visits	No. of Cities and Towns	Total Annual Cost
1909	4,723	28,442	13	$ 13,685.37
1910	31,369	290,963	213	127,368.41
1911	74,391	653,424	852	295,142.07
1912	125,310	938,673	1,368	429,604.86
1913	175,942	1,127,707	1,652	525,856.64
1914	192,335	1,060,288	1,804	527,861.64
1915	202,659	1,078,863	2,001	553,900.10
1916	221,566	1,189,828	1,862	612,935.72

The service was very rapidly extended, the greatest growth being made in the early years of the service. Since 1913 the rate of increase in the number of cases and visits has declined. This, as we shall see later, is in large part indicative of a better administrative control of the service. The Company has concentrated attention more and more upon obtaining the type of case best adapted to visiting nurse work in life insurance. The high water mark in the number of cases visited and visits made was in the fiscal year 1916, the figures being 221,566 and 1,189,828 respectively. The total annual cost has continuously increased in spite of the decrease in the number of visits between 1913 and 1915. This increase in the unit cost per visit is due to the necessarily increased charges made by associations, the increasing cost of supervision which the Company has instituted, and the general rise of incidental overhead charges.

This rapid growth has been made possible in the first place, because of the wide extension of public health nursing associations in many sections of the country. The work of the National Organization for Public Health Nursing has been most commendable in opening up new areas. In the second place the traveling field supervisors of the Company have encouraged the organization of nursing associations in communities where such societies did not exist. The town and country nursing service of the American Red Cross, the statewide development of public health nursing by state boards of health, as in Ohio, and the coöperative arrangements for state organization of public health nursing between the Company

and the state boards of health, as in North Carolina and in Virginia, are also very significant factors in the extension of public health nursing in the United States. The general policy of the Company is to employ existing public health nursing societies and associations, and newly founded organizations are accepted where practicable as soon as their work reaches the standards required by the Company. In a total of 843 services in 1916, nearly 500 were under the auspices of nursing associations; the rest, mostly in smaller communities which have no nursing associations, were in charge of the Company's individual nurses employed under contract either on a salary or on a visit basis. As in the nursing associations, these individual nurses of the Company with but few exceptions were required to be graduate nurses. It is a rule of the service that the standards maintained by the National Organization for Public Health Nursing shall be maintained, as far as possible, wherever the Company has jurisdiction.

ADMINISTRATIVE PROGRAMME.

From the beginning, the Company has endeavored to limit its public health nursing to diseases and conditions that have been demonstrated to yield the largest practical returns. The viewpoint has been that the service should be given to cases of acute illness, of accidents, and of after care of childbirth. Only secondarily was the service intended for the care of chronic diseases, and for the care of the acute stages of the chronic diseases. The Company has also insisted that the service shall be given and continued under medical supervision. It is, therefore, required that, after the initial visit, there shall be a physician in attendance in every case. In such cases as are found to be without physician, nurses are instructed to make every effort to bring a physician into the case and where they do not succeed, the case is at once closed. Finally, in a large group of cases not adapted to public health nursing, hygienic advice is given or arrangements are made for transfer to institutional care as indicated by circumstances in each case. These administrative rulings result in the following main division of cases according to the type of service given.

TABLE II.

NUMBER AND PERCENTAGE OF CASES IN MAIN CLASSES OF VISITING NURSE SERVICE—1916, 1915, 1914 COMPARED.

Class of Service	1916		1915		1914	
	No. of Cases	Per cent. of Total	No. of Cases	Per cent. of Total	No. of Cases	Per cent. of Total
Total service	217,422*	100.0	202,653*	100.0	188,154*	100.0
With phys. in attendance	186,821	85.9	174,806	86.3	163,534	86.9
Nursed	*137,865*	*63.4*	*125,530*	*61.9*	*111,959*	*59.5*
Advised	*32,768*	*15.1*	*33,388*	*16.5*	*33,504*	*17.8*
Not nursed	*16,188*	*7.4*	*15,888*	*7.8*	*18,071*	*9.6*
Without phys. in attendance	27,469	12.6	24,903	12.3	21,196	11.3
Nursed	*4,938*	*2.3*	*4,708*	*2.3*	*4,607*	*2.4*
Advised	*16,607*	*7.6*	*14,507*	*7.2*	*10,129*	*5.4*
Not nursed	*5,924*	*2.7*	*5,688*	*2.8*	*6,460*	*3.4*
Non-policyholders	3,132	1.4	2,944	1.5	3,424	1.8

* These figures are for the calendar years 1916, 1915 and 1914 and not for the fiscal years ending November 30, as in Table I.

The first five years of the operation of the service were given over to reaching as large a proportion of the Company's policyholders in the United States and Canada as possible. The last three years comprised in this review were devoted to increasing the efficiency of the Company's public health nursing. This programme consisted of strict application to such important matters as the coöperation of the Company's agency staff in securing the proper types of cases, educating visiting nurses in practical case management, obtaining discharge of cases to institutional care where such measures were indicated, and developing proper after-care for women in childbirth.

Thus, during the period 1914 to 1916 there was a decided increase in the percentage of cases actually nursed with physicians in attendance. In 1914, 59.5 per cent. of the total service was extended to cases which required nursing, and where there was a physician in attendance. In 1916, 63.4 per cent. of the total cases in the service were nursed under medical observation. There was a decided decline in the ratio of advisory service, from 17.8 per cent. of the total cases in 1914 to 15.1 per cent. in 1916. Cases which required no nurs-

ing were reduced in the service reports from 9.6 per cent. of the total in 1914 to 7.4 per cent. in 1916.

There was an increase in the proportion of all cases without physician in attendance, from 11.3 per cent. in 1914 to 12.6 per cent. in 1916. This increase is very largely accounted for by the rise in the proportion of cases of advisory service. Since these cases involve for the very largest number only one inspection visit this tendency toward increase is not very significant.

CLASSES OF PERSONS NURSED.

The persons reached by the Company's Visiting Nurse Service were very largely members of the wage-earning groups of the population, and the greater proportion of them, 87 per cent. in 1916, were white. The percentage of colored persons for the same year was 13 per cent. This is in fairly close agreement with the proportion of the two races in the general group of the Company's policyholders. Without distinction of color, 25 per cent. of the persons were males and 75 per cent. were females in the Visiting Nurse Service experience of 1916. The proportion of males in the general group of policyholders is considerably higher, however. This preponderance of nursing work among females has been observed by visiting nurse associations generally and is accounted for in the Metropolitan service by the large number of maternity cases. The aim of the service is to reach year by year an increasingly large number of males who today do not come within its scope. The Visiting Nurse Service reaches nearly twice the number of children under five than would be indicated by their proportionate representation in the entire group of policyholders. This may well be due to the very high sickness rates which prevail among children under five, particularly from the diarrheal and the communicable diseases. On the other hand, there are less than half as many patients relatively represented in the service between ten and nineteen years as there are policyholders for the same age period. For the adult ages twenty and over there is fairly close agreement between the proportion of patients and the proportion of policyholders.

The following table presents a comparison of the age characteristics of patients reached by the service, and of policyholders.

TABLE III.

PER CENT. DISTRIBUTION OF PATIENTS AND POLICYHOLDERS BY AGE PERIOD IN 1916.

Age Period	Patients, Per cent. of Total	Policyholders, Per cent. of Total
All ages	100.0	100.0
Under 5	16.4	8.4
5-9	11.9	13.5
10-14	5.7	11.9
15-19	4.8	11.0
20-39	35.3	32.4
40-59	18.0	17.4
60 and over	7.9	5.3

DISEASES AND CONDITIONS IN THE VISITING NURSE SERVICE OF 1916.

Considering only the 214,290 policyholders visited by the service during the calendar year 1916,* there are available a number of observations on the character of the diseases and conditions entering into the entire experience. Thus, typhoid fever was visited in 4,137 cases or 1.9 per cent. of the total. Malaria, a disease of the first importance as a public health problem in the South, was visited in 3,556 cases or 1.7 per cent. of the total cases in the service. Measles was reported in 5,348 cases or 2.5 per cent. The cases of the other communicable diseases of children did not constitute a considerable proportion of the service experience. Influenza was visited in 15,818 cases or 7.4 per cent. of the total recorded for the year. Tuberculosis of the lungs still constitutes quite a significant proportion of the cases. Of this disease there were 4,145 cases visited during the year or in 1.9 per cent. of the total service. Rheumatism accounted for 5,060 cases or 2.4 per cent. of the total. This term is used to describe a number of separate diseases and conditions simulating "rheumatism," and is perhaps as satisfactory a designation as can be secured

*There were 3,132 non-policyholders included in the total service figures in the preceding tables. We have isolated this group from the medical statistics of the service.

from the types of cases available in the service. Colds, coryza and rhinitis were represented in 5,300 cases or in 2.5 per cent. of the total service. Bronchitis was recorded in 6,484 cases or 3.0 per cent. of the total. Broncho and lobar pneumonia together accounted for 11,988 cases or 5.6 per cent. of the total service. Tonsillitis was another important element in the service, accounting for 8,146 cases or 3.8 per cent. of the total. Aftercare in childbirth was recorded in 23,896 cases or 11.2 per cent. of the total cases visited. Accidents and injuries were reported in 16,500 cases or 7.7 per cent. of the total service. Of this number, 2,948 were burns, representing 1.4 per cent. of the total service; 2,903 were fractures or 1.4 per cent. of the total cases and 3,763 were wounds of various kinds or 1.8 per cent. of the total. In the foregoing classification we have followed strictly the practice of Bellevue and Allied Hospitals and the figures thus shown are comparable with any compiled by that hospital or by other institutions employing the same classification. The foregoing facts are set forth in some detail in the following table:

TABLE IV.

PRINCIPAL DISEASES AND CONDITIONS IN ENTIRE VISITING NURSE SERVICE, 1916.

Disease or Condition	Number of Cases	Per Cent. of Total
All diseases and conditions	214,290	100.0
General diseases	51,569	24.1
Typhoid fever	4,137	1.9
Malaria	3,556	1.7
Measles	5,348	2.5
Scarlet fever	885	.4
Whooping cough	1,737	.8
Diphtheria and croup	1,263	.6
Influenza	15,818	7.4
Other epidemic diseases	3,049	1.4
Purulent infection and septicemia	750	.3
Tuberculosis of the lungs	4,145	1.9
Other forms of tuberculosis	1,113	.5
Cancers and other malignant tumors	1,958	.9
Rheumatism	5,060	2.4
Other general diseases	2,750	1.3
Diseases of nervous system and organs of special sense	10,313	4.8
Cerebral hemorrhage, apoplexy, paralysis	2,424	1.1
Neuralgia and neuritis	1,610	.8
Diseases of the eyes and their annexa	1,358	.6
Diseases of the ears	1,763	.8
Other diseases of nervous system	3,158	1.5
Diseases of the circulatory system	6,380	3.0
Organic diseases of the heart	2,457	1.1
Diseases of the veins	1,746	.8
Diseases of the lymphatic system	1,197	.6
Other diseases of the circulatory system	980	.5
Diseases of the respiratory system	27,501	12.8
"Colds," coryza and rhinitis	5,300	2.5
Bronchitis	6,484	3.0
Bronchopneumonia	2,470	1.2
Pneumonia (lobar and undefined)	9,518	4.4
Pleurisy	1,931	.9
Other diseases of the respiratory system	1,798	.8
Diseases of the digestive system	28,976	13.5
Tonsillitis	8,146	3.8
Diseases of the stomach	5,902	2.8
Diarrhea and enteritis (under 2 yrs.)	2,017	.9
Diarrhea and enteritis (2 yrs. and over)	3,655	1.7
Appendicitis	2,928	1.4
Other diseases of the digestive system	6,328	3.0
Non-venereal diseases of the genito-urinary system	11,575	5.4
Acute nephritis	455	.2
Bright's disease	2,023	.9
Other diseases of the kidneys	454	.2
Salpingitis and other diseases of female genital organs	2,229	1.0
Other non-venereal diseases of the genito-urinary system	6,414	3.0
The puerperal state	41,572	19.4
Abortions and miscarriages	3,469	1.6
Other accidents of pregnancy	483	.2
Pregnancy only	7,459	3.5
Pregnancy and aftercare	1,552	.7
Aftercare only	23,896	11.2
Puerperal septicemia	967	.5
Puerperal albuminuria and convulsions	308	.1
Other diseases and conditions of the puerperal state	3,438	1.6
Diseases of the skin	5,068	2.4
Diseases of the bones and organs of locomotion	2,394	1.1
External causes	16,500	7.7
Burns	2,948	1.4
Contusions	1,714	.8
Dislocations	246	.1
Fractures	2,903	1.4
Sprains	1,738	.8
Wounds	3,763	1.8
All other external causes	3,188	1.4
All other diseases and conditions	11,566	5.4
No illness	876	.4

GENERAL TENDENCY OF THE AVERAGE AMOUNT OF SERVICE.

The entire Visiting Nurse Service in the calendar year 1916 made precisely the same average number of visits as in 1915; namely, 5.5 visits per case. Considering only cases visited where there was a physician in attendance, the nursed cases registered the same average number of visits per case, 8.0 for both years; advised cases continued to show a decrease in the average number of visits per case. In 1914 the figure for advised cases having medical attendance was 2.0; the average number of visits for such cases was reduced to 1.3 in 1916. Cases visited with physician in attendance, but where neither advisory nor nursing service was indicated, showed 1.1 visits per case in 1916. These are very nearly always genuine cases of illness where the nurse is called upon to facilitate the removal of the patient to some institution or where the family is giving the patient proper attention. The following table displays the general tendency of the average amount of visiting nurse service extended to the main classes represented in the service reports:

TABLE V.

AVERAGE NUMBER OF VISITS PER CASE, MAIN CLASSES OF VISITING NURSE SERVICE IN 1916, 1915 AND 1914.

Class of Service	1916	1915	1914
All classes	5.5	5.5	5.8
With physician in attendance:			
Nursed	8.0	8.0	8.5
Advised	1.3	1.5	2.0
Not nursed	1.1	1.1	1.2

DURATION OF THE AVERAGE CASE.

One of the factors of case management in public health nursing is proper discharge of the case when the services of the nurse are no longer actually needed. The available statistics indicate that the Company's efforts in this direction have been productive. In part, the reduction in the duration of the average case for the entire service was due to the shifting of the classes of cases served and through necessary and desirable restrictions of the service. These important features of the service are shown in the following table:

TABLE VI.

AVERAGE DURATION OF CASES IN DAYS, MAIN CLASSES OF VISITING NURSE SERVICE OF 1916, 1915 AND 1914.

Class of Service	1916	1915	1914
All classes	9.0	9.7	13.0
With physician in attendance:			
Nursed	13.0	13.9	18.3
Advised	2.4	4.2	7.7
Not nursed	1.4	1.5	2.3

A glance at the above figures indicates that the service in its main characteristics is tending toward stability. The rate at which the duration of the average case is being reduced was much less in 1916 than in 1915. Thus, for nursed cases showing medical attendance, only one day was taken off the average in 1916 as compared with a reduction of four days during 1915 over the figure for the previous year. Advisory service showed a reduction to 2.4 days in 1916 from 4.2 days in 1915; in 1914 advised cases showed an average of 7.7 visits.

INCREASING THE FREQUENCY OF VISITS TO THE AVERAGE CASE.

Another factor in practical case management is the proper choice of cases and of the proper types, or stages, of certain diseases or conditions, especially chronic diseases. It is also of importance to increase the frequency of visits in the course of an acute case, during a pneumonia crisis, for instance. Constant emphasis upon these significant factors has produced appreciable shortening in the average time between visits. A considerable period in between visits would indicate probably that the service was not getting the acute types of cases in which actual nursing accomplishes the greatest results. Thus, while in 1914 a visit was made for the entire service, once every 2.2 days, in 1916 the average case received one visit every 1.6 days. This is one index that more suitable cases are being referred to the nurses and that cases receive nursing care more frequently during critical periods. The service to advisory cases was also intensified, from one visit every 3.8 days to one visit every 1.9 days. The foregoing facts are set forth in the following table.

TABLE VII.

NUMBER OF DAYS BETWEEN VISITS TO THE AVERAGE CASE, MAIN CLASSES OF VISITING NURSE SERVICE OF 1916, 1915 AND 1914.

Class of Service	1916	1915	1914
All classes	1.6	1.8	2.2
With physician in attendance:			
Nursed	1.6	1.8	2.2
Advised	1.9	2.9	3.8
Not nursed	1.3	1.4	1.8

RESULTS IN SECURING PROPER TYPES OF CASES.

A few additional figures give further reliable indications of the trend of the principal elements of the service. We computed an index figure for "acute service," "chronic service," and "maternity service." For each of the years 1914, 1915 and 1916 we selected the same group of diseases which had respectively, "acute" or "chronic" characteristics. The total amount of maternity service was also ascertained for each of the three years. The number of cases registered in each of these "acute," "chronic" or "maternity" groups was related to the total number of cases nursed with physician in attendance, and the index was expressed as a percentage. These indexes are shown in the following table:

TABLE VIII.

CHANGES IN INDEXES OF "ACUTE," "CHRONIC" AND "MATERNITY" NURSING.

Type of Nursing	1916	1915	1914
Acute diseases	29.8	28.1	26.9
Chronic diseases	9.1	10.2	11.8
Maternity cases	21.9	21.1	20.2

Thus the service to acute cases increased by nearly 3 per cent.; service to chronic cases showed a substantial decrease; and maternity service increased from 20.2 per cent. in 1914 to 21.9 per cent. in 1916.

It may be of interest also to observe the trend of the facts for the several diseases and conditions classified under the three foregoing broad groups of service. Under acute service, typhoid fever showed a significant decline in its percentage.

The four communicable diseases of children, however, increased from 2.5 per cent. of the total cases nursed with physician in attendance to 3.0 per cent. Influenza, on account of the widespread epidemic during the early part of 1916, increased from 4.6 per cent. to 7.5 per cent. Pneumonia showed an increase also from the figure recorded in 1914.

Tuberculosis of the lungs showed a decline in percentage from 3.2 per cent. to 2.0 per cent. between 1914 and 1916. The percentage of cancer declined from 1.3 per cent. to 1.2 per cent.; rheumatism was registered in 3.5 per cent. of the cases in 1914 and only 2.6 per cent. in 1916. Bright's disease and organic diseases of the heart also showed declines between 1914 and 1916. These facts are shown in greater detail in Table IX.

CONDITION OF PATIENTS ON DISCHARGE.

We believe our statistics on condition of discharge to be fairly reliable only for the two years 1915 and 1916. During 1914 we began to emphasize more and more the necessity for uniform modes of stating the conditions of patients on discharge. In 1915 our experience with the records returned to the office was such as to warrant our conclusion that the figures for that year would be fairly useful. Table X following shows the percentages for the several conditions on discharge for the entire Visiting Nurse Service in 1915 and in 1916 and for the nursed and advised cases where there was medical attendance.

TABLE IX.

COMPARISON OF RESULTS FOR CASES NURSED WITH PHYSICIAN IN ATTENDANCE, VISITING NURSE SERVICE OF 1914, 1915, 1916.

(Principal Diseases and Conditions Distinguished for General Types of Nursing.)

Type of Nursing and Disease or Condition	1916					1915					1914				
	Number of Cases	Per Cent. of Total	Av. Visits per Case	Av. Days per Case	Av. Days per Visit	Number of Cases	Per Cent. of Total	Av. Visits per Case	Av. Days per Case	Av. Days per Visit	Number of Cases	Per Cent. of Total	Av. Visits per Case	Av. Days per Case	Av. Days per Visit
Acute service:															
Typhoid fever	3,710	2.7	14.0	18.4	1.3	3,454	2.8	13.6	18.2	1.3	3,759	3.4	13.2	18.4	1.4
Four comm. diseases of children	4,140	3.0	5.8	10.0	1.7	3,228	2.6	6.3	11.7	1.8	2,775	2.5	6.4	13.7	2.1
Influenza	10,376	7.5	5.5	8.9	1.6	7,735	6.2	5.1	8.7	1.7	5,100	4.6	5.5	11.6	2.1
Diseases of the eyes	713	.5	7.8	14.0	1.8	673	.5	7.9	14.3	1.8	714	.6	7.9	17.6	2.2
Diseases of the ears	1,187	.9	8.0	13.3	1.7	960	.8	7.3	13.5	1.8	930	.8	8.1	15.8	1.9
Pneumonia—all forms	10,188	7.4	9.0	11.7	1.3	9,475	7.5	8.8	11.7	1.3	7,868	7.0	8.6	12.8	1.5
Pleurisy	1,520	1.1	8.9	14.3	1.6	1,419	1.1	8.6	14.3	1.7	1,233	1.1	8.0	15.0	1.9
Tonsillitis	4,857	3.5	4.1	6.5	1.6	4,318	3.4	4.1	6.5	1.6	4,085	3.6	4.2	7.6	1.8
Appendicitis	2,230	1.6	8.4	14.1	1.7	2,062	1.6	8.1	13.7	1.7	1,823	1.6	7.9	14.9	1.9
External causes:															
Burns	2,169	1.6	12.3	19.2	1.6	2,070	1.6	11.7	18.6	1.6	1,862	1.7	11.6	19.9	1.7
Chronic service:															
Tuberculosis of the lungs	2,771	2.0	10.4	26.2	2.5	3,249	2.6	11.3	36.6	3.2	3,615	3.2	13.2	72.4	5.5
Cancer	1,617	1.2	14.4	27.1	1.9	1,635	1.3	13.4	27.0	2.0	1,510	1.3	16.8	38.0	2.3
Rheumatism	3,572	2.6	9.9	18.9	1.9	3,362	2.7	9.5	19.5	2.0	3,927	3.5	10.3	25.5	2.5
Diseases of the veins (varicose veins, hemorrhoids)	1,304	.9	10.9	23.0	2.1	1,226	1.0	11.0	31.6	2.9	1,183	1.1	12.3	30.4	2.5
Bright's disease	1,583	1.1	9.9	18.2	1.8	1,463	1.2	10.2	19.8	2.0	1,430	1.3	11.0	26.2	2.4
Organic diseases of the heart	1,855	1.3	10.3	20.5	2.0	1,741	1.4	10.0	21.8	2.8	1,552	1.4	11.2	28.0	2.5
Maternity service:															
Accidents of pregnancy	3,257	2.4	6.7	9.1	1.4	3,005	2.4	6.7	9.5	1.4	2,666	2.4	6.7	10.6	1.6
Abortions and miscarriages	2,870	2.1	6.6	8.8	1.3	2,643	2.1	6.5	8.8	1.4					
Pregnancy only	292	.2	4.0	7.9	2.0	371	.3	5.2	10.9	2.1					
Pregnancy and after care	1,424	1.0	8.6	24.9	2.9	1,027	.8	7.1	8.7	1.2	15,870	14.2	7.0	10.9	1.6
After care only	20,788	15.1	7.1	8.4	1.2	18,133	14.4	7.1	8.7	1.2					
Puerperal septicemia	932	.7	12.8	15.7	1.2	962	.8	13.0	15.9	1.2	952	.9	12.4	17.2	1.4
Puerperal albuminuria	271	.2	11.3	16.6	1.5	269	.2	11.2	17.6	1.6	258	.2	10.9	21.9	2.0
Other dis. of puerperal state	3,225	2.3	10.3	13.7	1.3	2,700	2.2	10.3	14.1	1.4	2,846	2.5	10.4	16.3	1.6

TABLE X.

CONDITION OF PATIENTS ON DISCHARGE FROM VISITING NURSE SERVICE, 1916 AND 1915.

Condition on Discharge	Entire Service				Nursed Cases with Physician in Attendance				Advised Cases with Physician in Attendance			
	1916		1915		1916		1915		1916		1915	
	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.
All cases discharged	214,290	100.0	199,709	100.0	137,865	100.0	125,530	100.0	32,768	100.0	33,388	100.0
Recovered	55,203	25.8	41,265	20.7	47,345	34.3	36,200	28.8	2,923	8.9	2,116	6.3
Improved	103,275	48.2	104,868	52.5	69,519	50.4	69,700	55.5	15,785	48.2	17,617	52.8
Unimproved	34,019	15.9	30,726	15.4	13,083	9.5	12,102	9.6	10,208	31.2	9,160	27.4
Dying	347	.2	.....	.....	257	.2	.....	.....	29	.1	.....	.....
Dead	6,403	3.0	6,863	3.4	5,743	4.2	5,945	4.7	190	.6	363	1.1
Unspecified	15,043	7.0	15,987	8.0	1,918	1.4	1,583	1.3	3,633	11.1	4,132	12.4

In 1916 a little over one fourth of all cases (25.8 per cent.) were discharged as recovered. In addition, nearly one half (48.2 per cent.) were discharged as improved; together 74 per cent. were discharged as either recovered or improved. An additional 15.9 per cent. were unimproved. A little over 3 per cent. were discharged as dead or dying and the residual 7 per cent. were unspecified as to their condition on discharge. On comparing these figures with the corresponding ones for 1915, we find an increase in 1916 of 5 per cent. in the recovered cases with a decrease of nearly the same figure in the proportion of improved cases. We would suggest that these differences are complimentary in character and result from the effort made to standardize the use of the terms "recovered," "improved," etc. among the various nursing associations. A large number of cases which were reported as "recovered" in 1916 would undoubtedly have been registered as "improved" in the previous year. The other sets of figures show very slight differences, indicating that the service has reached a fairly fixed status as to the condition of the patients at the time of discharge. The decline in the percentage of cases reported as "unspecified" as to condition is, of course, gratifying since it indicates that greater care is now being taken by the nurses to specify the condition of the patient at the time of discharge.

As might be expected a larger proportion of cases were reported as recovered and improved in the group of cases nursed with physician in attendance than was found in the entire service. Together 84.7 per cent. were so discharged in 1916. A correspondingly smaller proportion of cases were discharged as "unimproved" than was found in the entire service. The proportion of "dead and dying" at the time of discharge was higher than in the entire service for the reason that the nursed cases are more likely to be carried on until the cases are closed by recovery or death. The proportion of cases "unspecified" as to condition on discharge was very low indeed, only 1.4 per cent.

PRACTICAL RESULTS IN NURSING AND CASE MANAGEMENT OF INDIVIDUAL DISEASES.

We have viewed generally the experience of the year 1916. Let us now inquire into the practical results of the year for a number of the particular diseases and conditions in comparison with the facts for the service for the two preceding years. By presenting these detailed facts we shall endeavor to show the probable effect of our programme to standardize the methods and policies of insurance public health nursing since 1914.

I. ACUTE DISEASES.

In a preceding section we observed that the relative amount of nursing in acute diseases had increased since we first started to emphasize the necessity for having a larger proportion of such cases in our work. The following remarks on the particular diseases will deal with this point at some length.

Typhoid Fever.

Typhoid fever is admittedly a disease in which excellent results have been achieved by visiting nursing. This fact is all the more significant when one considers that communities with poor facilities for institutional care of the disease are just as likely to have high typhoid fever incidence resulting from deficient means for safeguarding the public health against infection. Some effective means of nursing the disease and of protecting the members of households, in these communities especially, must be found. The practical experience of the Metropolitan justifies confidence in visiting nursing as one agency for the proper care of the disease.

In 1916, there were 3,710 cases of typhoid fever actually nursed with physician in attendance. The detailed facts of our experience with this disease over the three-year period 1914 to 1916 are shown in the following table:

TABLE XI.

TYPHOID FEVER NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	3,710	3,454	3,759
Per cent. of total nursed	2.7	2.8	3.4
Average visits per case	14.0	13.6	13.2
Average days per case	18.4	18.2	18.4
Time between visits (days)	1.3	1.3	1.4
Percentage recovered and improved	80.8	80.8	81.6
Percentage unimproved	15.3	14.9	12.8
Percentage dead	4.0	4.2	5.5
Percentage trans. to institutional care	19.2	17.7	15.2

The percentage of typhoid fever in the total nursed cases declined from 3.4 to 2.7 in three years. There was a slight increase in the average number of visits per case; the average duration of nursing remained practically the same; the time between visits was slightly shortened. The increase in the percentage of cases discharged as "unimproved," and the decrease in the ratio of deaths per 100 cases are probably due to the increased number and proportion of cases transferred to institutional care. The shortening of the time between visits may also have had some influence upon the bettering of the lethal rate* of this disease among our cases.

The value of modern visiting nursing treatment in typhoid fever is no longer open to question. Attention need only be directed to the remarkable improvement which has occurred in recent years in the death rates from typhoid fever in the industrial mortality experience of the Metropolitan Life Insurance Company. In 1911, 22.8 deaths occurred from typhoid fever per 100,000 persons exposed; in 1916, this rate had decreased to 13.0 per 100,000 or a reduction of 43 per cent. in 6 years. This favorable showing has resulted from the many activities centered on the control of typhoid fever, such as the purification of water supplies, the better control of sewerage in cities, the medical examination of food handlers and the inspection of foods. In addition, the evidence shows clearly that the visiting nurse work of the Company for its industrial policyholders has also played its part; for the relative reduction in the typhoid mortality experience of the Company's industrial

*Lethal rate = number of deaths per 100 cases.

department is higher than that for the Registration Area, with which experience it may be compared.

Visiting nursing in typhoid fever must also affect favorably the mortality rates from other diseases in the future. As has been pointed out in a report* issued by this Company, the complications of typhoid fever result in a high mortality in the years following recovery. Visiting nursing is effective in not only averting complications but also in reducing the number of secondary cases which ordinarily would occur in the immediate families of the patients. Altogether it must be conceded that visiting nursing today has one of its great opportunities in decreasing the case mortality of the disease, in disseminating information on the management of typhoid fever in the home and finally in bringing its collections of facts on typhoid fever prevalence to the attention of the health agencies which control the disease at its source.

Four Communicable Diseases of Children.

The following table shows the number and proportion of each of the four communicable diseases included in the total which will later be discussed in detail:

TABLE XII.

NUMBER AND PERCENTAGE OF FOUR COMMUNICABLE DISEASES OF CHILDREN IN 1916 NURSING EXPERIENCE; CASES WITH PHYSICIAN IN ATTENDANCE.

Communicable Diseases of Children	Number of Cases	Per Cent. of Total Four Communicable Diseases of Children
Total	4,140	100.0
Measles	2,442	59.0
Scarlet fever	437	10.6
Whooping cough	656	15.8
Diphtheria and croup	605	14.6

Measles accounted, therefore, for very nearly six-tenths of the cases to which we shall hereafter refer as "four communicable diseases of children."

For these diseases combined we registered 4,140 cases in 1916. There was a decided increase during 1916 in the percentage of such cases in the total service, due probably to the

* Dublin, Louis I., "Typhoid Fever and its Sequelae." Metropolitan Life Insurance Co., 1914.

epidemic of measles which prevailed rather generally in the United States throughout the spring of 1916. For the group, the average number of visits was reduced, the average period of nursing and the time between visits were shortened. These facts are shown in the following table:

TABLE XIII.

NURSING EXPERIENCE WITH FOUR COMMUNICABLE DISEASES OF CHILDREN, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	4,140	3,228	2,775
Per cent. of total nursed	3.0	2.6	2.5
Average visits per case	5.8	6.3	6.4
Average days per case	10.0	11.7	13.7
Time between visits (days)	1.7	1.8	2.1
Percentage recovered and improved	82.7	82.5	82.7
Percentage unimproved	13.1	13.6	13.0
Percentage dead	4.2	4.0	4.3
Percentage trans. to institutional care	10.1	9.4	8.5

The nursing of the communicable diseases of children is obviously as yet an undeveloped part of visiting nurse work. The number of cases will probably increase as the administrative opinion in regard to what constitutes safe nursing in these cases becomes more liberal. There is already a strong tendency to assume that these diseases may be properly cared for by general visiting nurses without endangering the health of other patients under the care of such nurses. The problem of cross-infection in connection with the nursing care of these diseases is one which should be approached on the basis of the established facts of experience. This subject will be further considered in relation to the work of the principal associations.

Malaria

In 1916 we nursed 2,466 cases which were reported as malaria. While this disease is relatively of minor importance in the entire service, it plays a large part in the public health nursing programme for the Company's policyholders in the southern states. In these areas malaria still prevails, in some sections at least, to a very disquieting extent.

There is under way an intelligently conceived programme for the reduction of the conditions which give rise to malaria in-

cidence in the South. The effort of the Company to be of service in this movement for the practical control of the disease is indicated by the following table, giving the number of cases nursed or advised with physician in attendance, in leading southern services during 1916:

TABLE XIV.

NUMBER AND PERCENTAGE OF MALARIA CASES NURSED AND ADVISED WITH PHYSICIAN IN ATTENDANCE IN LEADING SOUTHERN SERVICES, 1916.

City	Number of Cases	Per Cent. of all Diseases	Average Visits per Case
Birmingham, Ala.	73	9.8	4.5
Augusta, Ga.	71	17.4	5.6
Columbus, Ga.	149	15.5	5.1
Savannah, Ga.	133	22.6	3.1
New Orleans, La.	43	2.7	3.2
Charlotte, N. C.	14	3.9	4.4
Chattanooga, Tenn.	46	6.9	5.7
Memphis, Tenn.	583	26.5	3.6
Nashville, Tenn.	81	7.8	4.3
Norfolk, Va.	34	5.2	7.7

The foregoing table represents only those services in the South where malaria constituted a significant proportion of the total cases. There were other southern areas with equally large populations where the number of cases of malaria in our nursing experience was very small indeed. This indicates a variable distribution of the disease throughout the several distinct geographic areas of the South. In general, the cities located in the Appalachian Plateau and in the adjacent upland country, show a lower incidence of malaria than do the cities on the Atlantic and Gulf coastal plain or in the Mississippi valley.

The 2,466 cases of malaria nursed with physician in attendance during 1916 constituted 1.8 per cent. of the entire nursed cases. An average of 5.5 visits was made per case. The average duration of nursing care, 8.4 days, shows a reduction from the figure of 11.5 days recorded in 1914. The frequency with which visits were made also changed. In 1914 a visit was made once every 2.1 days; in 1916 the average malaria case was visited once in 1.5 days. These changes in these ratios indicate that we are perhaps getting more cases of malaria in the seriously

acute stages. There was a decided decline in the percentage of malaria cases transferred to institutional care.

TABLE XV.

MALARIA NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	2,466	2,482	2,020
Per cent. of total nursed	1.8	2.0	1.8
Average visits per case	5.5	5.4	5.5
Average days per case	8.4	9.3	11.5
Time between visits (days)	1.5	1.7	2.1
Percentage recovered and improved	96.7	97.2	96.5
Percentage unimproved	2.5	2.0	2.4
Percentage dead	.8	.9	1.2
Percentage trans. to institutional care	3.5	4.7	5.3

Influenza.

The epidemic of influenza, or of grippe-like infections of the respiratory tract which prevailed very generally over the United States during the later part of 1915 and the early months of 1916, left its distinct imprint upon the nursing experience of the service.

TABLE XVI.

INFLUENZA NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	10,376	7,735	5,100
Per cent. of total nursed	7.5	6.2	4.6
Average visits per case	5.5	5.1	5.5
Average days per case	8.9	8.7	11.6
Time between visits (days)	1.6	1.7	2.1
Percentage recovered and improved	95.3	95.9	96.0
Percentage unimproved	3.6	3.2	2.9
Percentage dead	1.1	.8	1.1
Percentage trans. to institutional care	6.0	5.8	4.5

There were more than twice as many influenza cases in the experience of 1916 than were recorded in 1914. The average number of visits per case remained practically stationary, but the average number of days of nursing was reduced in the three year period from 11.6 to 8.9. The time between visits was shortened from 2.1 to 1.6 days; this latter figure indicates more intense service and perhaps demonstrates that the cases

represented in the epidemic were of serious nature. This coincides with the clinical experience generally during the course of the epidemic. The distinctly higher death rates from influenza and from influenzal pneumonia in our industrial experience for the year 1916 support this contention.

Broncho- and Lobar Pneumonia.

It would be very desirable in this discussion to distinguish between the two main types of pneumonia, namely, broncho- and lobar. Unfortunately, the data were not definite enough in a sufficiently large number of the records to make it possible. In 1916, there were only 2,166 cases of bronchopneumonia so specified, nursed with physician in attendance, and 8,022 additional cases of pneumonia (lobar and undefined), making a total of 10,188 cases. In view of the large number of children nursed for these conditions, the true number of cases of bronchopneumonia must have been much larger. The composite treatment, however, will not be misleading because the various types of pneumonia require very similar nursing care. The figures at our disposal show much the same average number of visits per case, average duration per case, average days between visits as well as other similar characteristics of service for both forms of pneumonia.

Our nursing experience appears to indicate that of all the diseases and conditions which receive nursing care, pneumonia yields perhaps the largest practical results for the effort expended. Pneumonia nursing requires the same careful regard for the details of bedside treatment, the hygiene of the sick-room and the education of the members of the household as are indicated for typhoid fever. Apparently the same gratifying response to intensified nursing care is observed in our records for pneumonia as for the other diseases. In fact there is a well established current impression that the visiting nurse care of pneumonia in the home, especially with children, ultimately achieves better results than hospitalization of the disease. The statistical evidence in support of this statement is not at present entirely conclusive; from such data as are available, however, we may readily conclude that home nursing care of children sick with pneumonia is increasingly effective.

In 1916 there was an increase in the number of cases of pneumonia nursed with physician in attendance. The 10,188 cases of this type constituted 7.4 per cent. of the total nursed cases. In the previous year the proportion was 7.5 per cent. of all the cases. Epidemic conditions prevailed in both years.

TABLE XVII.

PNEUMONIA NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	10,188	9,475	7,868
Per cent. of total nursed	7.4	7.5	7.0
Average visits per case	9.0	8.8	8.6
Average days per case	11.7	11.7	12.8
Time between visits (days)	1.3	1.3	1.5
Percentage recovered and improved	83.7	83.7	84.7
Percentage unimproved	8.4	8.2	7.4
Percentage dead	7.9	8.1	7.9
Percentage trans. to institutional care	11.0	10.7	16.2

It is in comparison with the figures for 1914 that the more striking differences are found. Thus, since that earlier year the average number of visits per case has increased by one-half visit per case; the average duration of the case has decreased slightly more than one day, the time between visits being thus reduced. The percentage of cases transferred to institutional care has been very considerably reduced from 16.2 to 11.0 per cent. of all the cases. This reduction would seem to indicate that the more serious types of pneumonia which were formerly transferred to hospital care are now carried through to their termination either by recovery or death. It is, therefore, very significant to find that with the smaller percentage of transfers to institutional care there has been no increase in the percentage of cases reported as dead, namely, 7.9 per cent. of all the cases nursed with physician in attendance; the figures being the same for 1914 and 1916. This figure is undoubtedly less than the true lethal rate in pneumonia cases because a number of deaths must have occurred among our cases after they had been discharged by the nurse either to the family or to other institutions. The exact number of such fatal cases will remain unknown until a more elaborate method has been developed to keep track of the condition of

patients after the nursing care has been closed. The percentage of unimproved cases is only very slightly increased. All the facts at our disposal clearly indicate that very definite standards for the nursing of pneumonia have been established since 1915 and that these will be maintained.

Diarrhea and Enteritis.

Diarrhea and enteritis were nursed with physician in attendance in 3,970 cases, or in 2.9 per cent. of all cases in 1916. Since there are no significant differences between the nursing characteristics of the disease under and over three years of age, as classified originally in our statistics, the following table, giving the main facts of our nursing experience with diarrhea and enteritis, is presented without distinction of age:

TABLE XVIII.

DIARRHEA AND ENTERITIS NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	3,970	3,424	2,621
Per cent. of total nursed	2.9	2.7	2.3
Average visits per case	6.4	6.3	6.7
Average days per case	9.5	9.6	11.4
Time between visits (days)	1.5	1.5	1.7
Percentage recovered and improved	91.2	89.2	90.7
Percentage unimproved	5.1	5.5	4.3
Percentage dead	3.7	5.2	5.1
Percentage trans. to institutional care	8.2	7.1	3.2

There was an increase in the number and percentage of cases nursed by the service in 1916 over the figures recorded in 1915 and in 1914. The average number of visits per case remained about the same as in 1915 but was lower than in 1914. This fact is attributed largely to improvement in the management of adult cases of the disease. A similarly favorable reduction in the average period of nursing care per case was also accomplished since 1914, more emphatically with adult cases than with children under three years of age next birthday. From the statistics it appears that visits were made with greater frequency during the acute stages of the disease in 1916 than during 1914. Considerably more than

twice as many cases proportionately were transferred to institutions for care in 1916 than in 1914. Perhaps this explains the lower proportion of cases reported as dead on discharge.

The fact that in life insurance public health nursing, children under one year of age are not accessible to the nurse, in a measure diminishes the amount of diarrhea and enteritis work which a life insurance company can do. Nevertheless some emphasis upon diarrhea and enteritis nursing as a part of a health conservation programme is decidedly called for, more perhaps by the social factors of the disease than by the immediate problem of case fatality. The incidence of diarrhea and enteritis is a sensitive index of the health standards of communities. The visiting nurse care of the disease itself must be supplemented by public health measures which control its occurrence. For such child policyholders as are within the purview of the Service a substantial reduction in mortality has been accomplished. During the period 1911 to 1916 a reduction of 5.7 per cent. was achieved in diarrhea and enteritis mortality. Such reduction may be expected to result from visiting nursing measures which do much to diminish the severity of the attack and the consequent fatality rate of the disease.

Accidents and Injuries.

Accidents and injuries present the same general nursing characteristics as the acute diseases. Our figures for this class of service are interesting because we have a large number of such cases and because they bring us in touch with a considerable number of male policyholders. In fact, the accidents and injuries are the chief conditions recorded among the male policyholders reached by the Service.

During 1916, 16,500 cases of accidents and injuries were visited. Of this number, 11,038 or 66.9 per cent. were actually nursed under the direction of a physician. The remaining cases were advisory in character or were not actively nursed because of the absence of a physician. These averaged only a little more than one visit per case, indicating that the nurses were able either to effect a transfer of such cases to institutional care or to secure other provision for the welfare of

the injured patients. We shall, therefore, limit our extended discussion of this group of accident cases to those actually nursed with a physician in attendance.

The following table shows the experience of the Service with accident and injury cases nursed with physician in attendance, during the period 1914 to 1916:

TABLE XIX.

NURSING EXPERIENCE WITH EXTERNAL CAUSES, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	11,038	10,917	9,710
Per cent. of total nursed	8.0	8.7	8.7
Average visits per case	9.1	9.0	9.1
Average days per case	16.1	16.1	18.3
Time between visits (days)	1.8	1.8	2.0
Percentage recovered and improved	92.4	92.2	92.1
Percentage unimproved	6.5	6.5	6.6
Percentage dead	1.1	1.3	1.3
Percentage trans. to institutional care	13.3	12.6	11.1

While there was an increase in the actual number of accident and injury cases nursed during 1916 as compared with the previous years, the percentage of such cases to total declined somewhat. There was during 1916 practically a stationary average number of visits per case, 9.1 covering a period of 16.1 nursing days with a visit once every 1.8 days. There was a larger percentage of cases transferred to institutional care during 1916 than during 1915 or 1914. The proportion of recovered and improved cases is extremely high and fairly constant for the three year period. The proportion of those reported as "dead" is extremely low and indicates that these accidents and injuries were for the most part only minor conditions.

In 1916 it was possible for us to adopt a somewhat different mode of classifying the statistics of accidents in the Nursing Service. This consisted in grouping the cases to show the effect of the accidents, that is, whether they were burns, contusions, fractures, and other specific injuries. Formerly, the accident data were classified mainly according to means of injury, that is, whether the injury was affected by falling, by machinery, by cutting or piercing instruments, etc. This

new classification of the accident cases makes it possible for us to compare our findings essentially with the published reports of hospitals and other institutions employing the Bellevue and Allied Hospitals classification, which is indeed the one we adopted in our work. The following table shows the number of cases recorded for each type of injury:

TABLE XX.

NUMBER AND PERCENTAGE OF SPECIFIED INJURIES IN TOTAL ACCIDENTS AND INJURIES REPORTED BY VISITING NURSE SERVICE DURING 1916.

Injury	Number	Per Cent.
Total	16,500	100.0
Burns	2,948	17.9
Contusions	1,714	10.4
Dislocations	245	1.5
Fractures	2,903	17.6
Sprains	1,738	10.5
Wounds	3,763	22.8
All other and unclassified injuries	2,242	13.6
All other unspecified external causes	946	5.7

The wounds formed the most important group; there were 3,763 such cases reported during 1916 or 22.8 per cent. of the total accidents and injuries. The burns followed with 2,948 cases or 17.9 per cent. Fractures were next in importance with 2,903 cases or 17.6 per cent. of the total; followed by sprains with 1,738 cases or 10.5 per cent. and contusions with 1,714 cases or 10.4 per cent.

Considering only the nursed cases with physician in attendance, we find in the group of "burns" cases that an average of 12.3 visits was made per case covering a period of 19.2 days with a visit made on an average of 1.6 days. Thirteen and seven tenths per cent. (13.7 per cent.) of the cases were transferred to institutions and a little less than 93 per cent. of the cases were discharged as either recovered or improved.

Similarly, contusions showed an average of 6.7 visits per case nursed with physician in attendance over a period of 12 nursing days per case. Dislocations nursed with physician in attendance required an average of 9.9 visits over a nursing period of 19.1 days. Fractures averaged 11.3 visits over a period of 24 nursing days. Sprains which were actively

nursed showed an average of 6.9 visits over a period of 13.6 days. The wounds received 8.0 visits over a period of 13.1 days.

Nursing in life insurance health conservation work is especially useful in cases of accidents and injuries, not only because it prevents complications which so often arise, but because it is effective in shortening the period of disability for work.

From the foregoing detailed observation of a few of the diseases and conditions represented in our "acute" service classification, it will be seen that "acute" nursing as a group improved in the chief characteristics which distinguish this type of public health nursing: average visits per case; average days per case, and average time between visits.

II. CHRONIC DISEASES.

The main facts for the nursing of chronic conditions during the period 1914 to 1916 show that this type of nursing is being gradually reduced. Some of the individual diseases with chronic characteristics may now be examined.

Tuberculosis of the Lungs

This disease still forms a considerable proportion of the Company's nursed cases. The cases represented in our nursing experience of tuberculosis of the lungs fall into several groups:

(1) Incipient cases which require only instruction of the patient and of the family in personal hygiene, and where the nurse can urge sanatorium treatment. In many cases she arranges for the admission of the patient to a sanatorium.

(2) Moderately advanced cases which show promise of improvement from home treatment under proper medical observation and nursing care.

(3) Advanced and bedridden cases including those acutely sick, where transfer to institutional care would be either difficult or impossible.

The nursing experience with tuberculosis of the lungs is displayed in the following table.

TABLE XXI.

TUBERCULOSIS OF THE LUNGS NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	2,771	3,249	3,615
Per cent. of total nursed	2.0	2.6	3.2
Average visits per case	10.4	11.3	13.2
Average days per case	26.2	36.6	72.4
Time between visits (days)	2.5	3.2	5.5
Percentage recovered and improved	29.7	33.7	36.8
Percentage unimproved	38.5	34.9	29.1
Percentage dead	31.9	31.4	34.0
Percentage trans. to institutional care	36.5	31.9	30.4

With very nearly 500 cases less in 1916, and a substantial reduction in the amount, duration and intensity of service, the foregoing table presents quite a satisfactory showing. The rate of improvement in the several administrative elements of public health nursing service to tuberculosis seems to be slackening, however. In 1916 there was not such a decided improvement as that registered in the experience of 1915, considered on the basis of the 1914 record. It is possible that in the public health nursing of tuberculosis of the lungs there may be an "optimum" of (1) amount, (2) duration, (3) intensity of service. This point may now have been reached.

Cancer.

The amelioration of the condition of cancer patients, the promotion of their comfort and the easing of the burden of suffering allotted to these patients, is one of the important humanitarian services which public health nursing can render a group of the population at present but inadequately provided with proper medical and nursing facilities for cancer care. One valuable service, at least, which the public health nurse can often perform for the cancer patient is the transfer of the case to institutional care.

Cancer cases which come to the attention of the public health nurse may be considered under two heads: (1) those taken in the very earliest stages in which there is a reasonable certainty of cure through surgical procedure, and (2) those cases in which the prognosis is unfavorable and the work of the public health nurse is necessarily limited to acts of mercy

which lessen the sufferings of the patient and otherwise promote his or her comfort. The Company's experience with cancer cases nursed with physician in attendance is shown in the following table:

TABLE XXII.

CANCER NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	1,617	1,635	1,510
Per cent. of total nursed	1.2	1.3	1.3
Average visits per case	14.4	13.4	16.8
Average days per case	27.1	27.0	38.0
Time between visits (days)	1.9	2.0	2.3
Percentage recovered and improved	22.1	25.5	26.0
Percentage unimproved	41.5	38.9	33.6
Percentage dead	36.4	35.6	40.4
Percentage trans. to institutional care	32.0	29.2	22.3

There was only a slight reduction in the proportion of cancer cases in the total experience of the nursing service. The average number of visits per case in 1916 (14.4) was lower than the figure recorded in 1914; the average number of days of nursing for cancer cases (27.1) was nearly ten days shorter in the later year than in 1914. A visit is made to the average cancer case about once every two days.

The percentage of cases discharged "unimproved" has increased from 33.6 in 1914 to 41.5 per cent. in 1916. This probably reflects the increase in the percentage of transfers to institutional care. In 1916, 32.0 per cent. of the cancer cases were referred to institutions as compared with 22.3 per cent. in 1914.

Rheumatism.

Our rheumatism experience shows a substantial improvement. In 1914, 3.5 per cent. of the nursing cases were of this disease, or rather, group of diseases. In 1916, 2.6 per cent. of the cases were reported as "rheumatism." We realize that this term covers a multitude of separate diseases and conditions which have symptoms simulating "rheumatism." There is no reason to believe, however, that reporting practice for "rheumatism" has changed in 1916 from the practice of

1914. Our figures, therefore, are comparable throughout. A reduction in the average number of visits per case was accomplished, the average period of nursing care and the time between visits were shortened. These facts are shown in the following table:

TABLE XXIII.

RHEUMATISM NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	3,572	3,362	3,927
Per cent. of total nursed	2.6	2.7	3.5
Average visits per case	9.9	9.5	10.3
Average days per case	18.9	19.5	25.5
Time between visits (days)	1.9	2.0	2.5
Percentage recovered and improved	84.6	84.4	85.4
Percentage unimproved	13.6	14.0	13.1
Percentage dead	1.8	1.7	1.5
Percentage trans. to institutional care	17.9	18.5	15.6

Organic Diseases of the Heart.

"Organic diseases of the heart" represent several heart conditions, all of which are practically chronic in nature. Nursing is quite an essential element in the proper care of a cardiac patient during the acute attacks. On the preventive side, nurses are often enabled to secure suitably light occupations for patients whom they have nursed through an acute attack. In fact, the function of education in hygiene for the heart patient is only beginning to be realized. Public health nursing, therefore, may be considered an important aid in the control of this disease which, in the industrial mortality experience of the Company, is a cause of more deaths than any other single disease, except tuberculosis. In the mortality experience of the general population, heart disease causes more deaths than any other disease or condition, not even excepting tuberculosis. The public health nurse has, therefore, an important field of usefulness in the active nursing care of acute attacks of heart disease and in the education of heart patients in the care of themselves during quiescent periods. We give on the next page a table of our nursing experience with organic diseases of the heart.

TABLE XXIV.

ORGANIC DISEASES OF THE HEART NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	1,855	1,741	1,552
Per cent. of total nursed	1.3	1.4	1.4
Average visits per case	10.3	10.0	11.2
Average days per case	20.5	21.8	28.0
Time between visits (days)	2.0	2.2	2.5
Percentage recovered and improved	52.8	49.9	53.2
Percentage unimproved	24.3	25.0	22.4
Percentage dead	22.9	25.1	24.4
Percentage trans. to institutional care	26.8	20.8	18.9

From these figures it will be seen that heart diseases constituted a smaller percentage of the total nursing cases and that the time between visits has been shortened. The percentage of cases transferred to institutional care has increased.

Diseases of the Veins.

This group of diseases comprise for the most part varicose veins together with a few cases of hemorrhoids.

The conditions which we have classified as diseases of the veins present a number of unusual nursing characteristics. Varices, especially when they result in chronic painful ulceration, present an unusual opportunity for the good offices of the nurse in aiding to restore the patient to working efficiency. There is no significant problem of mortality in connection with varicose conditions. The chief element of nursing interest in cases of venous engorgement, especially when ulcers develop, lies in reducing the period of pain and physical disability for work. The statistics for this disease show that there has been a small reduction of percentage of cases in our nursing experience with a reduction in the average number of visits per case, the average number of days per case and the shortening of the time between visits. We are probably getting more suitable types of cases for nursing endeavor in this disease. The higher percentage of cases discharged "unimproved" parallels the rise in the percentage of cases transferred to institutional care. This is an indication that the nurses are doing good work in releasing cases which require surgical procedure. The foregoing facts are shown in the following table.

TABLE XXV.

DISEASES OF THE VEINS NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	1,304	1,226	1,183
Per cent. of total nursed	.9	1.0	1.1
Average visits per case	10.9	11.0	12.3
Average days per case	23.0	31.6	30.4
Time between visits (days)	2.1	2.9	2.5
Percentage recovered and improved	82.5	82.7	84.7
Percentage unimproved	16.9	16.7	14.8
Percentage trans. to institutional care	27.6	27.4	22.3

Bright's Disease.

Bright's disease is also a condition running a chronic course, with occasional periods of acute exacerbation requiring skilled nursing attention. Insistence upon proper types of cases and of transfer to family care of those Bright's disease patients whose condition does not justify our keeping the case upon the books, has resulted in a reduction of the percentage of such cases in our nursing experience. The average number of visits per case, and the average number of days per case have been reduced. The time between visits in Bright's disease cases has been shortened decidedly, indicating that the nursing service as a whole has responded to our request for better choice in the placement of visits and in the proper discharge of cases. There has been a significant rise in the percentage of cases discharged to institutional care. Our nursing experience with Bright's disease is shown in the following table:

TABLE XXVI.

BRIGHT'S DISEASE NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	1,583	1,463	1,430
Per cent. of total nursed	1.1	1.2	1.3
Average visits per case	9.9	10.2	11.0
Average days per case	18.2	19.8	26.2
Time between visits (days)	1.8	2.0	2.4
Percentage recovered and improved	48.4	50.2	48.6
Percentage unimproved	23.3	22.9	23.9
Percentage dead	28.2	26.9	27.5
Percentage trans. to institutional care	22.1	23.0	19.1

III. MATERNITY NURSING.

The nursing of maternity conditions has from the beginning played an important part in the visiting nurse work of the Company. Thus, in 1916, out of 160,843 female policyholders visited, 41,572 or 25.8 per cent. were directly concerned with diseases and conditions of the puerperal state. Of this number of cases, 36,815 or 88.6 per cent. were for women between the ages of 20 and 40 years. There were accordingly in 1916, 19.5 maternity cases per 1,000 female industrial policyholders at these childbearing ages. The corresponding rate in 1915 was 17.6 per 1,000 and in 1914 only 15.8 per thousand. It will be seen, therefore, that the Company's wish to extend the work of its visiting nurse service to an increasingly larger number of women among its industrial policyholders is meeting with the support of the policyholders themselves, of the nurses, and of the agency staff.

Of the total number of puerperal cases in 1916, 32,907 were normal, *i. e.*, were concerned either with prenatal care alone, with prenatal care continuing through and including "after care," or with "after care" in childbirth only. In addition, there were 3,469 cases of abortion and miscarriage, 967 cases of puerperal septicemia, and a residual group of 4,229 cases including a number of other acute diseases and conditions of the puerperal state. There were in all 39,438 cases (95 per cent. of the total) which were under the care of a physician. Of this number, 30,189 were actually nursed, 7,070 were advised and 2,179 were neither nursed nor advised. The following table displays the chief characteristics of the entire visiting nurse service in maternity conditions during 1916:

TABLE XXVII.

NUMBER OF CASES OF SEVERAL TYPES OF MATERNITY CONDITIONS VISITED IN ENTIRE NURSING SERVICE IN 1916.

Disease or Condition	No. of Cases	Per Cent. of Total Female Cases	No. of Visits	Av. Visits per Case	Av. Nursing Days per Case
Total puerperal state	41,572	25.8	243,738	5.9	7.9
Abortions and miscarriages	3,469	2.2	19,511	5.6	7.5
Other accidents of pregnancy	483	.3	3,143	6.5	9.9
Pregnancy only	7,459	4.6	8,566	1.1	1.7
Pregnancy and after care only	1,552	1.0	12,582	8.1	25.6
After care only	23,896	14.9	151,502	6.3	7.5
Puerperal septicemia	967	.6	11,947	12.4	15.2
Puerperal albuminuria and convulsions	308	.2	3,101	10.1	15.1
Other diseases and conditions of puerperal state	3,438	2.1	33,386	9.7	13.0

The cases received an average of 5.9 visits covering a period of 7.9 days of nursing care. The number of visits and the number of nursing days vary, of course, with the type of puerperal case. Where there are complications of any kind, the nurse is expected to give service precisely as she would in any other case of acute disease. We find, therefore, an average of 12.4 visits running over a period of 15.2 days to cases of puerperal septicemia and an average of 10.1 visits running over a period of 15.1 days in cases of puerperal albuminuria and convulsions. The above figures differ only slightly from those covering the year 1915. They thus indicate that the standards established in that year have been maintained. A new feature of the service in 1916 worthy of note was the increase in the number of cases of prenatal service. There were 7,459 cases visited during pregnancy which represents an increase of 1,764 cases over the preceding year.

For purposes of detailed analysis, we shall limit our remarks to the "nursed cases with physician in attendance." There were 30,189 such cases in 1916 representing 21.9 per cent. of the total nursed service. The following table shows the experience with maternity cases nursed with physician in attendance over the three year period, from 1914 to 1916.

TABLE XXVIII.

MATERNITY SERVICE, 1916, 1915 AND 1914; CASES NURSED WITH PHYSICIAN IN ATTENDANCE.

Class of Maternity Nursing	Number of Cases			Percentage of Total Nursed Cases		
	1916	1915	1914	1916	1915	1914
All maternity service	30,189	26,467	22,592	21.9	21.1	20.2
Accidents of pregnancy*	3,257	3,005	2,666	2.4	2.4	2.4
Abortions and miscarriages	2,870	2,643	†	2.1	2.1	†
Pregnancy only	292	371	†	.2	.3	†
Pregnancy and after care	1,424	1,027	15,870	1.0	.8	14.2
After care only	20,788	18,133	†	15.1	14.4	†
Puerperal septicemia	932	962	952	.7	.8	.9
Puerperal albuminuria and convulsions	271	269	258	.2	.2	.2
Other diseases of puerperal state	3,225	2,700	2,846	2.3	2.2	2.5

* Includes abortions and miscarriages.
† Not separately tabulated in 1914; included with "pregnancy and after care" in 1914.

The facts of the above table are encouraging. We find a continuous increase during the period in the proportion which the maternity cases formed of the total nursed cases. This is particularly true of the largest group, which has been designated "after care only." There is also a persistent decline in the proportion which the puerperal septicemia cases form of the total. This, we believe, reflects the careful work of the nurses in handling their cases both during pregnancy and after delivery. The infection of women in the course of accidents of pregnancy or during delivery or after delivery presents one of the most distressing conditions known to nursing experience. We shall now consider in some detail the nursing facts with reference to a number of the specific conditions observed in the foregoing table.

Accidents of Pregnancy.

In our experience with cases of this kind requiring actual nursing, the average number of visits remained stationary, the average number of days declined somewhat and the time between visits was shortened. These and other important facts are shown below:

TABLE XXIX.

ACCIDENTS OF PREGNANCY NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	3,257	3,005	2,866
Per cent. of total cases nursed	2.4	2.4	2.4
Average visits per case	6.7	6.7	6.7
Average days per case	9.1	9.5	10.6
Time between visits (days)	1.4	1.4	1.6
Percentage recovered and improved	92.9	92.7	92.4
Percentage unimproved	6.6	6.8	7.2
Percentage dead	.6	.5	.4
Percentage trans. to institutional care	10.0	11.1	10.1

After Care Only.

Our post-partum nursing experience in 1916 showed a stationary condition with respect to average number of visits, a slight increase in the average duration of nursing care, and no change in the frequency with which visits were made. The experience is shown in the following table.

TABLE XXX.

AFTER CARE IN CHILDBIRTH NURSING EXPERIENCE, 1916 AND 1915; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915
Number of cases	20,788	18,133
Per cent. of total nursed	15.1	14.4
Average visits per case	7.1	7.1
Average days per case	8.4	8.7
Time between visits (days)	1.2	1.2
Percentage recovered and improved	97.7	97.6
Percentage unimproved	2.3	2.3
Percentage trans. to institutional care	7.9	7.0

Until very recently the maternity work of the Company was limited practically to post-natal care. During 1916, the Service was considerably liberalized and more attention was paid to expectant mothers. Thus, in 1915 there were 5,695 cases of pregnancy only, with an average of 1.3 visits per case while in 1916 such cases comprised a total of 7,459 cases or 3.5 per cent. of the total service with 1.1 visits per case. In addition, there were in 1916, 1,552 cases of pregnancy carried through to after care in normal childbirth as compared with a figure of 1,147 in 1915.

Puerperal Septicemia.

The figures with respect to infection are presented in the following table:

TABLE XXXI.

PUERPERAL SEPTICEMIA NURSING EXPERIENCE, 1916, 1915 AND 1914; CASES WITH PHYSICIAN IN ATTENDANCE.

Item	1916	1915	1914
Number of cases	932	962	952
Per cent. of total nursed	.7	.8	.9
Average visits per case	12.8	13.0	12.4
Average days per case	15.7	15.9	17.2
Time between visits (days)	1.2	1.2	1.4
Percentage recovered and improved	84.0	84.2	81.9
Percentage unimproved	12.9	11.4	13.8
Percentage dead	3.1	4.4	4.3
Percentage trans. to institutional care	18.5	16.7	16.5

We have previously commented on the reduction in the number and proportion of puerperal septicemia cases. Along with this reduction in the frequency of the condition there was

to be observed a somewhat fluctuating average number of visits per case, a shortening of the average period of nursing care and a practically stationary condition with respect to the frequency of visits (1 visit every 1.2 days). There was a much larger percentage of such cases transferred to institutional care, which perhaps accounts in some measure for the increase in the percentage of cases discharged unimproved in 1916 and for the decrease in the percentage of cases reported dead. Our experience with puerperal septicemia is indeed an encouraging indication of the increasing effectiveness of public health nursing in maternity conditions.

During 1911, there were 70.1 deaths from causes associated with childbirth per 100,000 white female policyholders between the ages of 15 and 44. In 1916 the death rate from these conditions was reduced to 62.6 per 100,000, a decrease in the rate of 10.7 per cent. Among colored female policyholders the rate for mortality from causes connected with childbearing was 88.4 per 100,000 in 1911. This rate was reduced to a figure of 70.4 in 1916, a decline of 20.4 per cent. The consistent decline in mortality from puerperal conditions and diseases among both white and colored policyholders is in marked contrast to the mortality figures for the general population included in the Registration Area for deaths in the United States. In the five years prior to 1916, the death rate from the diseases connected with childbearing had been practically stationary. There is in these comparisons, therefore, a strong endorsement of the Company's programme of extending its facilities for public health nursing to parturient women.

NURSING RESULTS IN PRINCIPAL ASSOCIATIONS.

The foregoing observations have been based upon the nursing results of the entire service. Our figures have included the associations in the larger cities as well as the many individual services located in the smaller communities. It is generally agreed that the larger associations in the urban centres have developed much more efficient organizations, that their work is more subject to administrative control and has been much more standardized than is possible for the many smaller organizations with their more limited facilities.

It has seemed desirable, therefore, to prepare statistics covering the main points of the service as conducted by a group of the principal nursing associations of the country. We have chosen twelve for this purpose located in the following cities:

Baltimore	Cleveland
Boston	Manhattan and Bronx Boroughs, N. Y. City
Brooklyn	
Buffalo	Philadelphia
Chicago	Providence
Cincinnati	St. Louis
	Washington, D. C.

These associations are well known; many of them are of long standing and all of them are under competent management. The fundamental principles of visiting nursing are recognized by all of them. The results which are shown in the following table may, in many cases, serve as standards for the other and smaller societies. The following table presents a comparison of the several classes of service for the twelve principal associations contrasted with the corresponding figures for the entire Visiting Nurse service:

TABLE XXXII.

PERCENTAGE OF CASES IN SPECIFIED CLASS OF NURSING SERVICE, ENTIRE VISITING NURSE SERVICE AND TWELVE PRINCIPAL ASSOCIATIONS COMPARED, 1916.

Class of Service	Percentage of Total	
	Entire Service	Twelve Associations
All classes	100.0	100.0
With physician in attendance	87.2	88.5
Nursed	64.3	60.7
Advised	15.3	18.8
Not nursed	7.6	9.0
Without physician in attendance	12.8	11.5

It is, of course, evident that while there are indisputable bases for the operation of all visiting nurse societies in large cities, there must be a reasonably elastic administrative programme to meet local conditions. Thus, the twelve principal associations had a higher percentage of cases with physician in

attendance, 88.5 per cent. as compared with 87.2 per cent. in the entire service. The proportion of nursed cases under medical observation was less, however, than that recorded for the entire service. This reflects a higher ratio of advisory service, and suggests that the large city services have different programmes which provide for a greater amount of advisory service, for instance, in prenatal work. This latter branch of public health nursing activity is not so well developed in the many smaller services which this Company conducts as among the group of principal associations noted above. We find, furthermore, a higher percentage of "not nursed" cases in the twelve associations and this, as we shall see later, may be the result of the effort which these associations make to transfer certain types of cases to other treatment, especially hospitals and sanatoria whose facilities are more available in larger cities.

The experience shown for a public health nursing society is in a very large measure determined by such important local factors as the extent of hospital facilities in a given community, the degree to which physicians coöperate with the association, the attitude of the population served toward the work of the association, the density of the population, the character of the housing of the population, the nature of the industries which provide a means of livelihood for the community reached, and the funding conditions for philanthropic work in the local area.

EXPERIENCE OF ENTIRE SERVICE AND GROUP OF TWELVE ASSOCIATIONS COMPARED, 1916.

It will be of some interest in this connection to view comparatively the experience of the entire Visiting Nurse Service and the group of twelve principal associations with the several diseases and conditions nursed and advised with physician in attendance. There was a much greater percentage of typhoid fever in the entire service (2.3) than in the experience of the twelve city associations combined (1.0). This perhaps reflects the care which large cities have taken in recent years to safeguard their water and milk supplies. The nursing of the communicable diseases of childhood showed a slightly

greater proportion among the group of twelve principal associations than in the entire service. It will be recalled that the large associations in many instances have special facilities for the care of communicable diseases of children. This is reflected in the combined experience shown for this group of twelve public health nursing societies.

The influenza ratio was lower for the group of twelve associations than for the entire service, indicating perhaps that the epidemic of this disease did not affect the group of cities studied as much as it did the smaller associations which made up a large part of the experience of the entire service. Among the nursed and advised cases in total, tuberculosis of the lungs constituted about the same percentage in both experiences. The twelve associations show a much higher ratio of cases of the puerperal state, especially advisory cases of pregnancy and cases of after care in childbirth. Accidents and injuries as a class showed a slightly lower percentage for the twelve principal associations than for the entire service. This fact is perhaps accounted for by the more plentiful hospital and dispensary facilities in large cities. The foregoing facts and other relations between the entire service and the twelve principal associations are shown in Table XXXIII.

TYPES OF CASES IN SIX PRINCIPAL ASSOCIATIONS COMPARED.

While 88.5 per cent. of the total cases in the group of twelve associations showed a physician in attendance, only 82.2 per cent. were thus recorded in the Brooklyn service and 91.0 per cent. in the Boston service. Nursed cases with physician in attendance were recorded in 60.7 per cent. of the total service of the twelve principal associations. The Baltimore service showed only 43.4 per cent. nursed and the Boston association 76.8 per cent nursed with physician in attendance. Advisory service seemed to be represented in nearly one third of the total cases of the Philadelphia service and in only a slightly smaller proportion (31.6 per cent.) of the Baltimore service. The group of twelve principal associations showed 18.8 per cent. of the cases to have been advised with physician in attendance. Cases not nursed with physician in attendance were recorded in 9.0 per cent. of the service for the group of

TABLE XXXIII.

NUMBER OF CASES AND PERCENTAGE OF TOTAL; PRINCIPAL DISEASES AND CONDITIONS IN NURSED AND ADVISED SERVICE COMBINED; CASES WITH PHYSICIAN IN ATTENDANCE; ENTIRE VISITING NURSE SERVICE AND GROUP OF TWELVE PRINCIPAL ASSOCIATIONS COMPARED, 1916.

Disease or Condition	Entire Service		Twelve Principal Associations	
	No. of Cases	Per Cent. of Total	No. of Cases	Per Cent. of Total
All diseases and conditions	170,633	100.0	38,861	100.0
General diseases	42,548	24.9	8,020	20.6
Typhoid fever	3,929	2.3	387	1.0
Measles	3,902	2.3	927	2.4
Scarlet fever	708	.4	343	.9
Whooping cough	1,188	.7	224	.6
Diphtheria and croup	945	.6	367	.9
Influenza	12,735	7.5	1,982	5.1
Tuberculosis of the lungs	3,738	2.2	798	2.1
Other forms of tuberculosis	1,020	.6	200	.5
Cancer and other malignant tumors	1,793	1.1	489	1.3
Rheumatism	4,257	2.5	1,086	2.8
Other general diseases	8,333	4.9	1,217	3.1
Diseases of nervous system and organs of special sense	8,239	4.8	2,107	5.4
Cerebral hemorrhage, apoplexy, paralysis	2,148	1.3	639	1.6
Diseases of the eyes and ears	2,288	1.3	519	1.3
Other diseases of the nervous system	3,803	2.2	949	2.4
Diseases of the circulatory system	5,428	3.2	1,538	4.0
Organic diseases of the heart	2,180	1.3	549	1.4
Diseases of the veins	1,494	.9	522	1.3
Other diseases of the circulatory system	1,754	1.0	467	1.2
Diseases of the respiratory system	21,570	12.6	5,410	13.9
"Colds," coryza and rhinitis	1,929	1.1	373	1.0
Bronchitis	5,591	3.3	1,520	3.9
Bronchopneumonia	2,316	1.4	756	1.9
Pneumonia (lobar and undefined)	8,743	5.1	2,113	5.4
Other diseases of the respiratory system	2,991	1.8	648	1.7
Diseases of the digestive system	22,487	13.2	4,341	11.2
Tonsillitis	6,334	3.7	1,320	3.4
Diseases of the stomach	4,049	2.4	731	1.9
Diarrhea and enteritis	4,772	2.8	877	2.3
Other diseases of digestive system	7,332	4.3	1,413	3.6
Non-venereal diseases of the genito-urinary system	10,216	6.0	1,965	5.1
The puerperal state	37,259	21.8	10,492	27.0
Pregnancy only	5,739	3.4	2,578	6.6
Pregnancy and after care	1,521	.9	674	1.7
After care only	21,842	12.8	5,269	13.6
Other diseases and conditions of the puerperal state	8,157	4.8	1,971	5.1
Diseases of the skin	3,937	2.3	771	2.0
External causes	12,793	7.5	2,698	6.9
Burns	2,330	1.4	562	1.4
Contusions	1,277	.7	339	.9
Dislocations	202	.1	34	.1
Fractures	2,430	1.4	585	1.5
Sprains	1,272	.7	294	.8
Wounds	2,866	1.7	422	1.1
All other and unclassified injuries	1,643	1.0	327	.8
All other external causes	773	.5	135	.3
All other diseases and conditions	6,156	3.6	1,519	3.9

twelve associations, in 14.9 per cent. of the cases for Henry Street, 14.1 per cent. of the cases in the Brooklyn service and 9.9 per cent. in the Baltimore service. The Boston association Metropolitan cases showed only 1.4 per cent. to have been "not nursed with physician in attendance." The fact stands out that at present there is no uniformity in the main results of the leading services of the United States. The degree of development of the public health nursing programme differs in each of the cities. No permanent conclusions should be drawn from these comparative statements, therefore, until the influence of strictly local circumstances is discounted. The following table exhibits the main facts for the types of cases represented in the leading services:

TABLE XXXIV.

NUMBER OF CASES AND PERCENTAGE OF SEVERAL TYPES OF CASES IN EXPERIENCE OF TWELVE PRINCIPAL ASSOCIATIONS AND OF SIX LEADING PUBLIC HEALTH NURSING ASSOCIATIONS, 1916.

Association	Total No. of Cases, All Classes of Service	Percentage with Physician in Attendance				% Without Physician in Attendance
		All Classes	Nursed	Advised	Not Nursed	
Twelve principal ass'ns.	48,861	88.5	60.7	18.8	9.0	11.5
Henry St. Settlement	9,981	87.2	60.6	11.6	14.9	12.8
Brooklyn D. N. Comm.	4,893	82.2	46.4	21.6	14.1	17.8
V. N. Ass'n of Chicago	6,877	85.0	71.6	8.9	4.6	15.0
V. N. Soc. of Philadelphia	5,860	90.6	53.6	32.8	4.2	9.4
Inst. V. N. Ass'n of Baltimore	2,219	84.9	43.4	31.6	9.9	15.1
Inst. Dist. Nursing Ass'n of Boston	4,701	91.0	76.8	12.7	1.4	9.0

Let us now view the experience of the chief services with respect to the important diseases and conditions.

EXPERIENCE OF INDIVIDUAL ASSOCIATIONS FOR CERTAIN DISEASES AND CONDITIONS.

Four Communicable Diseases of Children.

The nursing experience of the group of twelve principal associations and of each of the six leading societies in this group, was compiled to bring out the chief characteristics of the nursing work in connection with a number of important diseases and conditions. The first of these groups of diseases was the four communicable diseases of children, namely,

measles, scarlet fever, whooping cough and diphtheria. For the twelve principal associations there was a decrease in the percentage of this group of diseases of children from 5.1 in 1914 to 4.5 in 1916. A comparison of the experience of each of the six associations is shown in the following table:

TABLE XXXV.

NURSING EXPERIENCE OF TWELVE PRINCIPAL ASSOCIATIONS COMBINED AND OF SIX PRINCIPAL ASSOCIATIONS SINGLY, WITH FOUR COMMUNICABLE DISEASES OF CHILDREN, 1916; CASES NURSED WITH PHYSICIAN IN ATTENDANCE.

Association	No. of Cases	Per Cent of Total, All Diseases	Av. Visits per Case	Av. Days per Case	Av. Days per Visit	Percentage			% To Institutional care
						Recovered	Improved	Dead	
Twelve principal ass'ns . . .	1,347	4.5	6.9	14.5	2.1	66.7	20.1	3.3	15.5
Henry St. Settlement.	587	9.7	8.2	13.2	1.6	83.2	6.7	3.9	9.9
Brooklyn D. N. Comm. . . .	140	6.2	5.9	13.4	2.3	47.9	45.0	2.9	19.4
V. N. Ass'n of Chicago . . .	360	7.3	6.0	19.5	3.2	55.2	31.2	3.6	22.0
V. N. Soc. of Philadelphia.	11	.4	8.2	16.4	2.0	18.2	54.5	. . .	9.1
Inst. V. N. Ass'n of Baltimore.	4	.4	3.5	8.0	2.3	. . . .	33.3	. . .	100.0
Inst. D. N. Ass'n of Boston.	171	4.7	5.3	11.6	2.2	76.6	11.7	1.2	12.9

The individual services show a varying percentage of these diseases in the total nursing experience. Thus, while the twelve principal associations showed 4.5 per cent., Henry Street Settlement showed 9.7 per cent., the maximum for this series, the societies in Philadelphia and Baltimore showed four tenths of 1 per cent., the minimum for this series. The active nursing of these diseases in the work of a general public health nursing society or association is dependent in many instances upon the facilities of a particular association for carrying on this work in such a manner that cross-infection will not be incurred. The Henry Street Settlement has apparently worked out a definite and satisfactory program for the care of these diseases.

The remaining statistics for this group of diseases show no particular tendency toward uniformity.

Tuberculosis of the Lungs.

The public health nursing associations were perhaps the first to demonstrate the possibilities for public health nursing of tuberculosis and for education of families in the prevention of further infection. Tuberculosis of the lungs constituted

only 2.0 per cent. of the total cases nursed in the group of twelve principal associations. The Henry Street Settlement showed the same percentage as the group of twelve services. In Boston there was found the least percentage of tuberculosis (1.0) and in Philadelphia, the highest (3.9). The average number of visits per case tended to fluctuate considerably above the figure of 9.1 for the group of twelve services taken together. Thus, though the Chicago service gave only 4.0 visits per case (the minimum) with a very high percentage of cases transferred to institutional care, the Philadelphia service showed an average of 12.8 visits with a low figure of transferred to institutional care (40.0 per cent.). The available facilities for institutional care, and the readiness with which the nursing associations take advantage of such existing facilities, evidently have profound influence upon the figures of tuberculosis public health nursing. It must be remembered that the types of cases admitted to service have much to do with the results exhibited. Thus, an association which has opportunity to reach incipient cases is likely to show a high percentage of transfers where sanitorium facilities for such cases are available. If the cases come to an association as bedridden and *in extremis*, the association is not likely to report a high percentage of institutional transfers but perhaps, a fairly high average number of visits with a short period between visits. It has not been possible to separate the cases

TABLE XXXVI.

NURSING EXPERIENCE OF TWELVE PRINCIPAL ASSOCIATIONS COMBINED AND SIX PRINCIPAL ASSOCIATIONS SINGLY, WITH TUBERCULOSIS OF THE LUNGS, 1916; CASES NURSED WITH PHYSICIAN IN ATTENDANCE.

Association	No. of Cases	Per Cent of Total, All Diseases	Av. Visits per Case	Av. Days per Case	Av. Days per Visit	Percentage			% To Institutional Care
						Recovered	Improved	Dead	
Twelve principal ass'ns ...	593	2.0	9.1	21.9	2.4	.3	16.5	29.4	54.1
Henry St. Settlement.....	121	2.0	8.9	14.1	1.6	....	17.4	24.0	62.8
Brooklyn D. N. Comm....	39	1.7	11.5	23.9	2.1	....	15.4	35.9	59.0
V. N. Ass'n of Chicago ...	77	1.6	4.0	8.6	2.1	....	3.9	11.7	87.0
V. N. Soc. of Philadelphia.	122	3.9	12.8	40.1	3.1	....	11.7	55.0	40.0
Inst. V. N. Ass'n of Baltimore.....	23	2.4	4.4	8.3	1.9	....	9.5	9.5	87.0
Inst. D. N. Ass'n of Boston.....	35	1.0	9.0	19.0	2.1	2.9	28.6	28.6	40.0

in our statistics according to stage of disease nursed. If such a classification were possible, additional facts of some importance would have been available for quotation in this report. The accompanying Table XXXVI gives the tuberculosis of the lungs experience for the year 1916.

Rheumatism.

There is a tendency for cases of this type to center about 3 per cent. as the ratio in the total nursed cases. The average number of visits per case, however, varies considerably, dependent principally upon the number of cases transferred to institutional care and upon the acute or chronic character of the cases nursed. There was an average of 10.2 visits per case for the twelve associations. The Baltimore association showed the least average number, 4.6, and the Chicago association the greatest average number of visits, 11.6 per case. The average number of nursing days varied considerably from the average of 21.7 for the twelve associations combined. The Baltimore association showed the lowest figure, 10.4 days per case, and the Chicago association the highest, 29.7 days. The average number of days per visit, our index of the time between visits, varied also. There was a visit once every 2.1 days for the group of twelve associations. Henry Street showed the least interval between visits, 1.7 days, and Philadelphia the greatest interval, 3.0

TABLE XXXVII.

NURSING EXPERIENCE OF TWELVE PRINCIPAL ASSOCIATIONS COMBINED, AND OF SIX PRINCIPAL ASSOCIATIONS SINGLY, WITH RHEUMATISM, 1916; CASES NURSED WITH PHYSICIAN IN ATTENDANCE.

Association	No. of Cases	Per Cent. of Total, All Diseases	Av. Visits per Case	Av. Days per Case	Av. Days per Visit	Percentage			% To Institutional Care
						Recovered	Improved	Dead	
Twelve principal ass'ns ...	879	3.0	10.2	21.7	2.1	26.4	56.3	1.8	28.4
Henry St. Settlement.....	176	2.9	11.5	19.3	1.7	44.0	37.7	1.1	38.6
Brooklyn D. N. Comm....	77	3.4	9.2	20.3	2.2	16.9	70.1	1.3	37.7
V. N. Ass'n of Chicago ...	120	2.4	11.6	29.7	2.6	10.8	69.2	5.0	30.0
V. N. Soc. of Philadelphia.	91	2.9	9.8	29.1	3.0	23.1	58.2	1.1	21.1
Inst. V. N. Ass'n of Baltimore.....	38	3.9	4.6	10.4	2.3	....	72.2	2.8	73.7
Inst. D. N. Ass'n of Boston.....	123	3.4	11.2	23.8	2.1	48.0	33.3	.8	27.6

days. The Baltimore association showed the highest percentage of rheumatism cases discharged to institutions, 73.7 per cent., and the Philadelphia association the least percentage, 21.1. Table XXXVII gives the main facts of our rheumatism service.

Bronchitis.

The nursing service to bronchitis shows quite some variation in its percentage of total nursed cases. For the twelve principal associations combined, 3.9 per cent. were bronchitis. The Baltimore association showed the least percentage, 1.1, and the Boston association the highest, 5.2. There were for the twelve associations combined 6.4 visits per case. The Henry Street Settlement showed the highest average visits, 7.9, and the Baltimore association the least, 3.4 per case. The Chicago association showed the longest duration of nursing for bronchitis, 15.3 days per case, and the Baltimore association the least, 5.9 days per case. A visit was made every two days for the bronchitis cases in the group of twelve principal associations. Henry Street Settlement showed the least interval between visits and the Chicago service the greatest. The Baltimore service discharged the highest percentage of bronchitis cases to institutions (many to its own list) and Henry Street Settlement the least. The foregoing facts are shown in the following table:

TABLE XXXVIII.

NURSING EXPERIENCE OF TWELVE PRINCIPAL ASSOCIATIONS COMBINED AND OF SIX PRINCIPAL ASSOCIATIONS SINGLY, WITH BRONCHITIS, 1916; CASES NURSED WITH PHYSICIAN IN ATTENDANCE.

Association	No. of Cases	Per Cent. of Total, All Diseases	Av. Visits per Case	Av. Days per Case	Av. Days per Visit	Percentage			% To Institutional Care
						Recovered	Improved	Dead	
Twelve principal ass'ns ...	1,161	3.9	6.4	12.8	2.0	52.2	39.4	2.7	12.1
Henry St. Settlement.....	277	4.6	7.9	10.9	1.4	83.4	10.8	2.2	8.3
Brooklyn D. N. Comm....	93	4.1	6.3	12.4	2.0	46.2	47.3	...	19.4
V. N. Ass'n of Chicago ...	250	5.1	5.2	15.3	3.0	32.4	60.4	1.6	20.9
V. N. Soc. of Philadelphia.	117	3.7	6.1	13.4	2.2	39.7	47.4	5.2	8.5
Inst. V. N. Ass'n of Baltimore.....	11	1.1	3.4	5.9	1.8	....	81.8	9.1	81.8
Inst. D. N. Ass'n of Boston.....	186	5.2	6.4	14.8	2.3	67.0	23.2	2.7	8.6

Pneumonia.

The nursing experience for pneumonia in the year 1916 is of exceedingly great interest. The Henry Street Settlement again showed the highest percentage of cases of this disease in the total nursing experience. The twelve associations combined registered 8.8 per cent. for pneumonia, the Henry Street figure was 15.3 per cent. and Chicago, which showed the least percentage, had a figure of 6.4. Henry Street showed the highest average visits per case, 12.9, and the greatest frequency of visits, namely, 1 visit every day. This is coupled with the highest percentage of recoveries. The Brooklyn service showed an average of 8.2 visits, 1 visit every 1.6 days. The Philadelphia service, which showed an average of 8.8 visits per case, also visited pneumonia cases once every 1.6 days. The facts shown in the following table bear out the Company's attitude toward increasing the frequency of visits during the critical stage of illness, in order to shorten the nursing period and to increase the percentage of recovered and improved cases.

TABLE XXXIX.

NURSING EXPERIENCE OF TWELVE PRINCIPAL ASSOCIATIONS COMBINED AND OF SIX PRINCIPAL ASSOCIATIONS SINGLY, WITH PNEUMONIA—ALL FORMS, 1916; CASES NURSED WITH PHYSICIAN IN ATTENDANCE.

Association	No. of Cases	Per Cent. of Total, All Diseases	Av. Visits per Case	Av. Days per Case	Av. Days per Visit	Percentage			% To Institutional Care
						Recovered	Improved	Dead	
Twelve principal ass'ns ...	2,624	8.8	10.0	13.3	1.3	54.9	25.6	8.9	13.7
Henry St. Settlement.....	925	15.3	12.9	13.5	1.0	79.2	3.3	7.0	12.1
Brooklyn D. N. Comm....	235	10.3	8.2	13.1	1.6	55.7	31.1	7.2	15.7
V. N. Ass'n of Chicago ...	316	6.4	8.5	16.0	1.9	44.6	34.5	8.2	17.1
V. N. Soc. of Philadelphia.	263	8.4	8.8	13.9	1.6	45.2	31.2	14.4	9.5
Inst. V. N. Ass'n of Baltimore.....	95	9.9	6.5	10.5	1.6	19.1	53.2	13.8	45.3
Inst. D. N. Ass'n of Boston.....	238	6.6	8.1	12.4	1.5	63.9	10.5	8.8	16.8

After Care in Childbirth.

The group of twelve principal associations showed a percentage of these cases, 17.1, which was higher than that for the nursing experience of the entire Visiting Nurse Service, 15.1. The Baltimore service showed the least percentage of

after care cases in the nursing experience, 2.4, and the Philadelphia service the maximum percentage, 30.8. The average number of visits per case for the twelve associations was 7.9 per cent.; Henry Street Settlement showed a figure of 6.4 visits, the Baltimore service 5.6 and the Chicago service, 6.9 visits. The twelve associations combined showed an average of 10.1 days with a visit once every 1.3 days. The same frequency was observed for Henry Street, Brooklyn and Chicago. The Philadelphia service showed a visit once every 1.4 days, whereas in Baltimore and Boston visits were made with lesser intervals than for the average of the twelve associations. Baltimore is clearly not concerned with the care of normal maternity, the cases being transferred to other agencies. The facts for after care in childbirth are displayed in the following table:

TABLE XL.

NURSING EXPERIENCE OF TWELVE PRINCIPAL ASSOCIATIONS COMBINED AND OF SIX PRINCIPAL ASSOCIATIONS SINGLY, WITH AFTER CARE IN CHILDBIRTH, 1916; CASES NURSED WITH PHYSICIAN IN ATTENDANCE.

Association	No. of Cases	Per Cent. of Total, All Diseases	Av. Visits per Case	Av. Days per Case	Av. Days per Visit	Percentage			% To Institutional Care
						Recovered	Improved	Dead	
Twelve principal ass'ns ...	5,084	17.1	7.9	10.1	1.3	68.0	29.1	...	9.6
Henry St. Settlement.....	633	10.5	6.4	8.1	1.3	82.4	15.1	.2	11.7
Brooklyn D. N. Comm....	318	14.0	7.3	9.2	1.3	82.4	15.7	...	15.4
V. N. Ass'n of Chicago....	612	12.4	6.9	9.1	1.3	53.2	40.7	...	29.9
V. N. Soc. of Philadelphia.	966	30.8	7.6	10.3	1.4	84.8	14.6	...	4.1
Inst. V. N. Ass'n of Baltimore.....	23	2.4	5.6	6.3	1.1	8.7	87.0	...	39.1
Inst. D. N. Ass'n of Boston.....	592	16.4	7.1	8.7	1.2	95.6	2.9	.2	3.6

Abnormal Conditions of the Puerperal State.

The nursing of these conditions, as was pointed out in a previous section of this report, provides an exceptional opportunity for the service of the public health nurse. The twelve principal associations showed 6.2 per cent. of the total cases to have been abnormal conditions of the puerperal state, such as septicemia, albuminuria, accidents of pregnancy and accidents of labor. The Philadelphia service showed the highest percentage of abnormal conditions of the puerperal

state, 7.2, and the Brooklyn service the least, 3.1. The twelve associations combined gave an average of 9.5 visits per case for a period of 14.1 days or 1 visit every 1.5 days. The Chicago service showed the highest average period of nursing care, 20.2 days, but also the greatest interval between visits, 2.1 days. With the exception of the Baltimore service, where a number of transfers to the general list of that association disturbed the percentage for institutional care, the Brooklyn service showed the highest percentage of such discharges in cases of abnormal puerperal conditions. The available facts on the nursing experience of abnormal conditions of the puerperal state are shown in the following table:

TABLE XLI.

NURSING EXPERIENCE OF TWELVE PRINCIPAL ASSOCIATIONS COMBINED, AND OF SIX PRINCIPAL ASSOCIATIONS SINGLY, WITH ABNORMAL CONDITIONS OF THE PUERPERAL STATE, 1916; CASES NURSED WITH PHYSICIAN IN ATTENDANCE.

Association	No. of cases	Per Cent. of Total, All Diseases	Av. Visits per Case	Av. Days per Case	Av. Days per Visit	Percentage			% To Institutional Care
						Recovered	Improved	Dead	
Twelve principal ass'ns ...	1,843	6.2	9.5	14.1	1.5	56.3	36.0	.8	12.2
Henry St. Settlement.....	337	5.6	9.1	11.8	1.3	73.1	17.3	...	17.3
Brooklyn D. N. Comm....	71	3.1	9.8	14.0	1.4	50.7	38.0	...	29.6
V. N. Ass'n of Chicago ...	185	3.8	9.5	20.2	2.1	50.3	40.4	1.1	16.8
V. N. Soc. of Philadelphia.	226	7.2	9.7	14.5	1.5	72.9	20.4	.9	8.9
Inst. V. N. Ass'n of Baltimore.....	35	3.6	6.3	9.5	1.5	11.4	60.0	8.6	45.7
Inst. D. N. Ass'n of Boston.....	211	5.8	10.6	17.8	1.7	75.2	17.6	1.0	8.1

Accidents and Injuries.

The Baltimore service for several years has registered the highest percentage of cases of accidents and injuries. In 1916, 11.0 per cent. of the cases were so reported. The average for the twelve associations combined was 7.3 per cent. The Philadelphia service showed the least percentage of accidents and injuries, 5.6 per cent. The twelve principal associations registered an average of 9.6 visits per case. The figure was higher for the Chicago and Boston services (10.5 visits per case in each city) and also for the Philadelphia

service, 9.9 visits per case. The Baltimore service showed the least average, 5.7 visits per case.

An average of 19.9 days of nursing was accorded by the twelve associations combined. In Philadelphia the figure was 27.4 and in Baltimore 13.0 days per case. The figures displayed for Baltimore must be considered in the light of the transfers of accident cases from the Metropolitan list to the general list of the association. In accident cases a visit was made once every 2.1 days for the group of twelve associations. The greatest time between visits was displayed by the Philadelphia service, 1 visit every 2.8 days, and the least interval by the Henry Street Settlement, 1 visit every 1.9 days. The accident experience of the leading services is shown in the following table:

TABLE XLII.

NURSING EXPERIENCE OF TWELVE PRINCIPAL ASSOCIATIONS COMBINED AND OF SIX PRINCIPAL ASSOCIATIONS SINGLY, WITH ACCIDENTS AND INJURIES, 1916; CASES NURSED WITH PHYSICIAN IN ATTENDANCE.

Association	No. of Cases	Per Cent. of Total, All Diseases	Av. Visits per Case	Av. Days per Case	Av. Days per Visit	Percentage			% To Institutional Care
						Recovered	Improved	Dead	
Twelve principal ass'ns ...	2,157	7.3	9.6	19.9	2.1	37.9	51.2	1.8	26.0
Henry St. Settlement.....	365	6.0	9.1	17.2	1.9	44.2	42.0	1.6	42.9
Brooklyn D. N. Comm....	192	8.5	8.8	18.2	2.0	38.0	47.4	2.6	37.0
V. N. Ass'n of Chicago ...	404	8.2	10.5	24.3	2.3	41.3	50.0	1.0	25.6
V. N. Soc. of Philadelphia.	175	5.6	9.9	27.4	2.8	28.6	58.3	4.0	17.8
Inst. V. N. Ass'n of Baltimore.....	106	11.0	5.7	13.0	2.3	11.9	76.2	2.0	61.5
Inst. D. N. Ass'n of Boston.....	274	7.6	10.5	21.5	2.1	58.2	32.6	1.5	17.2

COST OF THE SERVICE.

Table I showed the statistics of total cost of the Visiting Nurse Service in each of the fiscal years since its inception. During the calendar year 1916, 217,422 cases were closed by the service and these cost, in total, $613,030.25. The average case nursed with physician in attendance cost $4.12 during the calendar year 1916. For some diseases this cost per case was higher than for others. Thus, typhoid fever showed an average cost per case of $7.21 and puerperal septicemia an average cost per case of $6.59. Colds, coryza and

rhinitis on the other hand showed a low average cost of $1.49 and cases of tonsillitis, an average of $2.11.

TABLE XLIII.

COMPARISON OF RESULTS IN CONTROL OF COST OF NURSES' VISITS. PRINCIPAL DISEASES AND CONDITIONS, ENTIRE VISITING NURSE SERVICE OF 1916, 1915 AND 1914; CASES NURSED WITH PHYSICIAN IN ATTENDANCE.

Disease or Condition	Average Cost per Case		
	1916	1915	1914
All diseases and conditions	$4.12	$4.10	$4.22
Typhoid fever	7.21	6.98	6.56
Malaria	2.83	2.77	2.73
Measles	2.73	2.92	2.83
Influenza	2.83	2.62	2.73
Tuberculosis of lungs	5.36	5.80	6.56
Cancer, all forms	7.42	6.87	8.35
Cerebral hemorrhage, apoplexy and paralysis	5.51	5.54	6.41
Organic diseases of the heart	5.30	5.13	5.57
Diseases of the veins	5.61	5.64	6.11
Colds, coryza and rhinitis	1.49	1.59	1.54
Bronchitis	3.04	2.92	3.03
Bronchopneumonia	4.38	4.36	4.32
Pneumonia-lobar and undefined	4.69	4.57	4.22
Tonsillitis	2.11	2.10	2.09
Diarrhea and enteritis	3.30	3.23	3.33
Appendicitis	4.33	4.16	3.93
Bright's disease	5.10	5.23	5.47
Salpingitis and other diseases of female genital organs	4.22	3.95	4.13
The puerperal state (total)	3.97	3.95	3.83
Accidents of pregnancy	3.45	4.21	3.33
Pregnancy only	2.06	2.67	2.44
Pregnancy and after care in normal childbirth	3.71	4.36	3.53
Puerperal septicemia	6.59	6.67	6.16
Puerperal albuminuria and convulsions	5.82	5.75	5.42
Other diseases and conditions of puerperal state	5.30	5.28	5.17
External causes (total)	4.69	4.62	4.52
Burns	6.33	6.00	5.77

In general there was but slight change in the cost figures of the acute diseases and conditions for which visiting nurse standards already exist. Typhoid fever, however, cost an average of $7.21 in 1916 as compared with $6.56 in 1914, and pneumonia increased in average cost from $4.22 in 1914 to $4.69 per case in 1916. The most striking decreases in the average cost per case were achieved for the chronic diseases and conditions. Tuberculosis of the lungs declined in average cost per case from $6.56 in 1914 to $5.36 in 1916; cancer cases cost an average of $8.35 in 1914 as compared with $7.42 in 1916. Similarly favorable reductions were accomplished for cerebral hemorrhage, apoplexy and paralysis cases, cases of organic diseases of the heart, diseases of the veins, and Bright's disease.

EFFECT OF THE VISITING NURSE SERVICE UPON THE MORTALITY EXPERIENCE OF POLICYHOLDERS.

Until recently no statistics have been available to determine, even approximately, the effect which the Visiting Nurse Service of the Company may have had on the mortality experience of the policyholders in the Industrial Department. It is now possible to offer a table showing the comparative reductions in the mortality from all causes and from certain of the principal causes of death among policyholders of the Company, and in the general population of the Registration Area of the United States. We shall limit this comparison to the five year period between 1911 and 1915. Figures for 1916 are available for the policyholders of the Company but not for the general population, for which 1915 is the last year of record. The following table presents this comparison:

TABLE XLIV.

COMPARISON OF DEATH RATES PER 100,000 LIVING; PRINCIPAL DISEASES AND CONDITIONS; METROPOLITAN LIFE INSURANCE COMPANY, INDUSTRIAL DEPARTMENT AND REGISTRATION AREA OF THE UNITED STATES, 1911-1915.

Diseases and Conditions	Metropolitan Life‡		United States Registration Area‡		Percentage, 1915 of 1911 Rate	
	1915	1911	1915	1911		
	Rate per 100,000	Rate per 100,000	Rate per 100,000	Rate per 100,000	Met.	U. S. Reg A.
All diseases and conditions....	1130.9	1253.0	1350.2	1415.9	90.3	95.1
Typhoid fever.....	12.9	22.8	12.4	21.0	56.6	59.0
Measles, scarlet fever, whooping cough, diphtheria.....	36.6	58.9	32.7	49.0	62.1	66.7
Tuberculosis (all forms).....	197.8	224.6	145.8	158.9	88.1	91.8
Tuberculosis of lungs.....	180.0	203.0	127.7	138.0	88.7	92.5
Acute and chronic bronchitis.	11.5	15.2	17.3	19.5	75.7	88.7
Pneumonia (all forms)*.....	106.5	115.2	132.7	133.7	92.4	99.3
Diarrhea and enteritis.....	34.4	37.9	24.3†	28.3†	87.5	85.9†
Cirrhosis of liver.....	14.0	16.3	12.5	14.0	85.9	89.3
Puerperal diseases and conditions (females, ages 15-44 yrs.)§.....	65.3	72.9	61.6	64.5	89.6	95.5
External causes.....	88.2	97.9	99.9	107.4	90.1	93.0

* Includes broncho- and lobar pneumonia.

† Diarrhea and enteritis deaths and estimated population under one year of age excluded in computing this rate.

‡ Metropolitan exposure and deaths contain no persons under one year of age; Registration Area rates are on basis of estimated population and deaths at all ages. See notes † and §.

§ Mortality rate from puerperal diseases, in both Metropolitan and Registration Area experiences, computed upon basis of total female estimated exposure, 15 to 44 yrs., and deaths of females, 15 to 44 yrs.

The mortality experience of the Company has constantly improved during this period, showing a decline of 9.7 per cent. in the mortality from all causes. In the same period of five years the decline in the death rate in the population of the Registration Area was only 4.9 per cent. The improvement was, therefore, almost twice as great among the policyholders of the Company as in the general population. The importance of these reductions in the insurance experience is indicated by the fact that had the 1911 rate continued into 1915 the number of deaths that would have occurred would have been 11,800 more than were actually registered. This number is so large that it gives much encouragement to continue the various activities in which the Company has been engaged for the conservation of human life.

The reduction in the rate of mortality is much more marked for certain causes of death than for others. Typhoid fever, for instance, had a rate of 22.8 per hundred thousand in 1911 and only 12.9 in 1915. The latter rate represents a reduction of 43 per cent. in the five year period. The corresponding reduction in the Registration Area was 41 per cent. For the group of the four infectious diseases of children, namely, measles, scarlet fever, whooping cough and diphtheria, there was a reduction of 38 per cent. among the policyholders and of 33 per cent. in the general population. The improvement in the tuberculosis death rate is very encouraging. For all forms of tuberculosis, the 1915 rate was 12 per cent. under that for 1911, although the reduction in the Registration Area was only a little over 8 per cent.

Pneumonia (all forms) on a similar basis shows a reduction of 7.6 per cent among the policyholders and of less than 1 per cent. in the general population. The puerperal diseases and conditions show a reduction of 10.4 per cent. in the policyholder death rates of the five year period as against no reduction whatever in the Registration Area. For this important group of conditions we have necessarily limited our comparison to females in the age period 15 to 44. Finally, the reduction in the rate for the group of accidents and injuries was 9.9 per cent. among the insured and only 7.0 per cent. in the population.

It will be observed that the improvement found in the Metropolitan experience is uniformly greater than that in the population at large. Furthermore, the greatest reductions appear in those conditions which are most prominently represented in the records of the Visiting Nurse Service. The Service has from the very beginning placed the greatest stress on the acute diseases and conditions such as typhoid fever, pneumonia, the puerperal diseases and the accidents and injuries (external causes), and has given only secondary consideration to the chronic conditions like cancer and heart disease. This administrative policy is apparently reflected in the mortality returns; the best reductions appear where the greatest nursing effort has been expended. It is, of course, impossible in this discussion to disassociate the effect of the nursing service from that of the other activities of the Company and from the results of the public health work of the communities. The extensive distribution of the Company's educational literature, the coöperation with health officers and the very excellent activities of so many of the local and state departments of health, have all played an important part in determining the favorable returns. But the country-wide extension of the nursing service to include over two hundred thousand patients annually, the intensive work done often in the nature of emergent relief, the education in personal hygiene which follows the more than a million visits made by the nurses to industrial homes, together must be credited with a large share in the mortality reduction which we have described above. In no other way can we explain the much more favorable condition which prevails among the insured than among the general population.

REVIEWS AND NOTES.

An Introduction to Statistical Methods. By Horace Secrist, Ph.D. New York: The Macmillan Co., 1917. Pp. VIII, 482.

Into a field that has been demanding adequate treatment for some time, the entry of Professor Secrist's book is most welcome. The author emphasizes the study of statistics as a method and a means, rather than an end in itself, and addresses himself to three classes of readers: college students, statisticians, and business executives. As a manual for statisticians, the volume carries much valuable information and is most suggestive; the reviewer is inclined to question, however, whether the book will at all points be clear to the other two classes.

The author displays wide reading, and handles his material with skill. He is particularly to be commended for devoting his main attention rather to business or economic statistics than to vital statistics, which, although an important branch of statistics, is becoming of lesser interest to general students of statistical method. For example, the discussion of the lack of coördination in much of the statistical effort of today (pp. 33–37), and of the nature of statistical units (pp. 59–63), shows commendable familiarity with and emphasis upon the growing field of economic statistics.

On the other hand, is it wise to fill a book—even one dealing with method—with so much detail as to the statistical activity of governmental bureaus? I refer to the description of existing wage statistics and their tabulation (pp. 94–104). Again, condensation would have improved such other sections as the detailed discussion of American index numbers (Chap. X, in part) the discussion of methods of ascertaining the arithmetic mean, and some of the longer tables on correlation, such as Tables E and F.

The first three chapters are admirable for the statistical beginner. They deal with the meaning and application of statistics, with the collection of data, and with units of measurement. Chapters V, VI, and VII, dealing with tabular and graphic presentation, are also helpful. Chapter IV is an illustrative section on statistical method, using the subject of wages as typical. The discussions of averages and index numbers, Chapters VIII and IX, introduce some material that is over the heads of the average student or business man, the same being true in larger measure of the remaining chapters, especially the discussion of dispersion and skewness and of correlation.

Furthermore, doubt may be expressed whether some of the definitions and discussions are sufficiently clear for the beginner in statistics. Take, for instance, the discussion of how to smooth a curve or graph (pp. 229–231), and the brief reference to interpolation (p. 270). These are matters clear enough to the practicing or professional statistician; it is questionable, however, whether a representative college student or business man would

gain a clear conception of them from the discussion. This seems all the more unfortunate, as the general arrangement of the volume is excellent, the chapters are carefully arranged and well annotated, and there is a consistent effort throughout to state the problems as introduced and to summarize the conclusions of each chapter.

Again, the distinction between *diagrammatic* and *graphic* presentation (Chaps. VI and VII) seems loosely drawn for the beginner. In fact, there is no direct definition of either method of presentation. The nearest approaches to a definition of diagrammatic presentation are the two statements that "diagrams are generally illustrations of conclusions from analysis" (p. 159), and that they represent an effort "to introduce devices for showing the proportional relations between facts, and to emphasize the concepts of space and movement" (p. 162). Graphic presentation is stated to deal "with graphs or curves of various types which show the distribution of data at a given time or the sequence of data over a period of time" (p. 193). The graphic method is further described as more inclusive than the diagrammatic, because graphs "may be used advantageously in connection with averages and other summary expressions" (p. 158), and because they emphasize continuity and relation more strikingly than diagrams in that they are uninterrupted (p. 193). Is it meticulous to suggest that these distinctions as stated may leave the beginner in a state of mental confusion?

A few omissions and inconsistencies may be noted. In treating of the utilization of statistics within business units (p. 11) there is no reference to an income account or a balance sheet—a rather curious omission of perhaps the most significant of all corporate statistics. They are accounting statistics, it is true, yet they also represent a high level of statistical method. In the discussion of mechanical systems of tabulation on page 127, a typographical error misspells the name "Hollerith." The author discusses the wage statistics of the Interstate Commerce Commission (pp. 94–95), but overlooks the latest developments, made effective July 1, 1914, by which railway employees are now classified in 68 groups, while their compensation is reduced to an hourly rather than a daily basis. Reference to the Commission's statistical report for 1915 would have obviated this oversight.

However, these are insignificant slips of the pen in a work that displays sound scholarship and wide application of existing material. The book contains much of value for the student, if he knows how to skip details; much good reference material for the statistician; much food for thought for anyone interested in current methods of statistical tabulation and presentation. It is a distinct contribution and may especially be commended to readers of these QUARTERLY PUBLICATIONS.

J. H. P.

A NOTE ON KING'S ARTICLE ON "THE CORRELATION OF HISTORICAL ECONOMIC VARIABLES AND THE MISUSE OF COEFFICIENTS IN THIS CONNECTION."

Errors in the conception of correlation and the use of the correlation coefficient are so common a vice of pseudo-scientific research that any attempt to correct their influence would be a bootless task. Mistakes of this sort mark the beginnings of any newer branch of scientific knowledge and may be looked upon as natural growing pains. Were Dr. King's article in the December number of the QUARTERLY PUBLICATIONS the first fruit of an immature worker in an uncultivated field, it might be allowed to pass without comment. But Dr. King's standing among American statisticians and the appearance of his article in the publications of the American Statistical Association place the matter in a different light, and justify an explicit challenge to the contentions he sets forth.

The gist of Dr. King's argument runs as follows: (1) the correlation coefficient is being employed to demonstrate utterly fallacious conclusions, especially in the analysis of historical data; (2) such errors rest in part upon neglect of the fact that correlation always indicates causation; (3) in part the errors are due to failure to separate adequately the forces contributing to the given events; (4) if causal forces are thoroughly isolated, correlation in every case will be perfect; (5) for demonstrating whether correlation does or does not exist, "no coefficient equals the graphic method"; (6) in the study of historical economic variables, the correlation coefficient serves but one purpose—namely, to measure the lag, if there be any.

One need not question Dr. King's contention that the correlation coefficient has been too often employed to support conclusions which have been "utterly fallacious and entirely contrary to the facts." Few statistical devices are "foolproof," and the more delicate the device the more liable it is to misuse by the inexpert. Dr. King's indictment, however, might well have been made more specific. Blundering by the novice is one thing; error by the scientist is another. One can not but feel that much of Dr. King's bill of complaint is irrelevant to the work of statisticians of measurable professional standing. If this be the case, the fact might well have been made clear.

But it is in his analysis of correlation and the correlation coefficient that Dr. King is most unfortunate. His discussion of the nature of correlation is so extreme and inflexible as to be wholly misleading. To Dr. King, correlation invariably connotes established causal relationship. Since "every cause must produce its effect exactly and invariably," it follows that "there can be no such thing as imperfect or partial correlation." "Every correlation to exist must be perfect." Correlation coefficients less than unity indicate that cause and effect have not been completely isolated; they evidence the confusion or deficiency of our measurements, not any imperfection of the correlation itself.

If correlation were being defined *de novo*, it is possible that this view might prevail. But the term "correlation" has an established meaning.

Correlation is not identical with causation, though closely connected with it. Correlation connotes a tendency toward persistent association. In other words correlation is "a tendency toward concomitant variation." As Bowley states it (Elements of Statistics, p. 316): "When two quantities are so related that the fluctuations in one are in sympathy with the fluctuations of the other, so that an increase or decrease of one is found in connection with an increase or decrease (or inversely) of the other, and the greater the magnitude of the change in the one, the greater the magnitude of the change in the other, the quantities are said to be correlated." By established usage and authority, correlation is nothing more than "one-to-one" correspondence in paired items of selected variables.

If this is the nature of correlation, what is its relation to causation? The case of perfect correlation may be first considered. Perfect correlation is a theoretical or conceptual limit to the more or less imperfect correlations of the world of experience.* Actual correlations, nevertheless, sometimes approach perfect correlation so closely as to share its nature. Such approximately-perfect correlations afford indisputable evidence of (1) joint characteristics of single entities (*e. g.*, the height and weight of adult males), or (2) that consistent routine of events which we designate causal connection. Complete correlation in the first of these cases informs us that we may expect to find invariably associated with a given characteristic of an object a stated measure of a second characteristic. Complete correlation in the second case informs us that we may expect to find a given event—designated cause—invariably followed by a second—designated effect.†

If correlation were always perfect, the problem would be relatively simple. Unfortunately for Dr. King's exposition, data drawn from experience—even artificially controlled experience—never exhibit perfect correlation. The essential task of correlation studies lies in the interpretation of concrete evidence, not in the understanding of conceptual limits. In general the question raised by actual data is a question of probability: Do the data show a degree of correspondence greater than was to have been expected from chance? If not, there is no evidence of a tendency toward persistent association, and hence no evidence of correlation. If the degree of correspondence, however, exceeds that which was to have been expected from chance, correlation may be postulated with a confidence varying directly as the excess.

It is clear enough that, when cause and effect are absolutely segregated, correlation becomes complete and obvious. Such complete—or virtually complete—segregation of forces is the ideal of causal analysis. Dr. King cites three reasons for the failure of economic analysis to attain this ideal: (1) failure to comprehend the factors involved; (2) lack of information essential to the separation of the forces; (3) ignorance of proper statistical methods. Unfortunately he neglects the reason which is most funda-

* An analogous statement may be made, of course, of perfect independence.

† Conceivably the joint characteristics of the first case may be thought of as coupled effects of a common cause; thus bringing the case within the class of causal connections. But ordinarily nothing is to be gained by this view of the matter. Whether or not the two cases at bottom are alike causal, their separation in practice is helpful.

mental: the practical impossibility of isolating economic forces completely. Dr. King, in suggesting the complete segregation of forces in economic analysis, is not merely giving a counsel of perfection; he is proposing what is manifestly impossible. The events of economic life are the product of an intricate, complex, maelstrom of forces. Economic science is replete with examples of the misfortunes attending attempts to abstract influences from this social complex: what the analysis gains in simplicity, it loses in reality and applicability. Segregation of forces in economic analysis must be effected with the utmost care, and can never be more than partial.

Dr. King makes much of a parallel between the methods of economic and physical science. Unquestionably economic research might profit greatly from wider and more intimate acquaintance with the methods of the more exact sciences. But a warning should be given against the tendency of making research in social science an exact and mechanical process. It is unsafe to conduct economic studies with mathematical automatons. In the first place, in most cases the original measurements are not sufficiently accurate to justify refined methods of analysis. And secondly, the analysis itself is a succession of acts of selection and interpretation calling for the highest order of intelligence. If left to itself, statistical method soon runs amuck. If it is to be successful, there must be wise and steadying guidance. Nothing is more mistaken than the widely-held notion that statistical method, because of the precision of its mathematical processes, yields perfectly dependable results. It is to be hoped that statistical method will make the hypotheses of economic science somewhat more trustworthy; for with the aid of this method *presumptions* of causal connection may surely be more firmly established. But it is one of the unavoidable limitations of economic science that its laws must remain openly in the presumptive form. Fortunately the laws may be made to serve none the less as satisfactory working hypotheses for private and public policy.

Nothing that has been said should be construed as in opposition to as thorough a separation of forces as is practicable in economic analysis. In the study of time series, secular trend, cyclical movements, and seasonal fluctuations should be carefully distinguished. Data should be selected with a view to their "greatest possible homogeneity." Studies of correlation should be supplemented with studies of "partial correlation." Unfortunately these latter practices, involving as they do a restriction of the "universe of discourse," sacrifice wealth of material to uniformity of data, and by basing conclusions necessarily upon a smaller body of evidence increase the probable error of the result. When all is said and done, a large margin of uncertainty thus is bound to persist in economic science. Much more is to be gained by acknowledging this fully than by underrating its significance.

Dr. King's argument leads him to discount the use of the correlation coefficient. If all correlations were perfect, he could well afford to do so; perfect correlation, if actually encountered, would be simple enough to deal with. It is just because correlation is never perfect that the coefficient is invaluable. As has been stated, the significance of a given association of

paired variables depends entirely upon the extent to which the association exceeds that to be expected from chance. The correlation coefficient enables an exact measurement of this all-important relationship. For this purpose curves are worthless. Curves may yield valuable suggestions for further study; they may prove effective graphic representations of correlation. In general they are a treacherous instrument for *proving* correlation. For this purpose nothing equals the correlation coefficient.

In the analysis of time variables, Dr. King would limit the use of the coefficient to the measurement of lag. Nothing could be more ill-advised. It is true that the correlation coefficient in its original form was not adapted to the study of fluctuations in time. But the "method of differences" corrects this deficiency and restores the coefficient to its position as the most serviceable measure of correlation, for historical as for other variables.

It is difficult to say to what extent the defects of Dr. King's article arise from mere excess of statement in giving a warning, the need of which all might concede. Dr. King's contributions to the literature of statistics are a sufficient guarantee that we need fear no abuse of statistical method at his hands. Unfortunately his December article gives no equal assurance for others. Upon the contrary there is reason to believe that it will add materially to that confusion regarding the nature of correlation and the correlation coefficient which it has been Dr. King's intention to correct.

EDMUND E. DAY.